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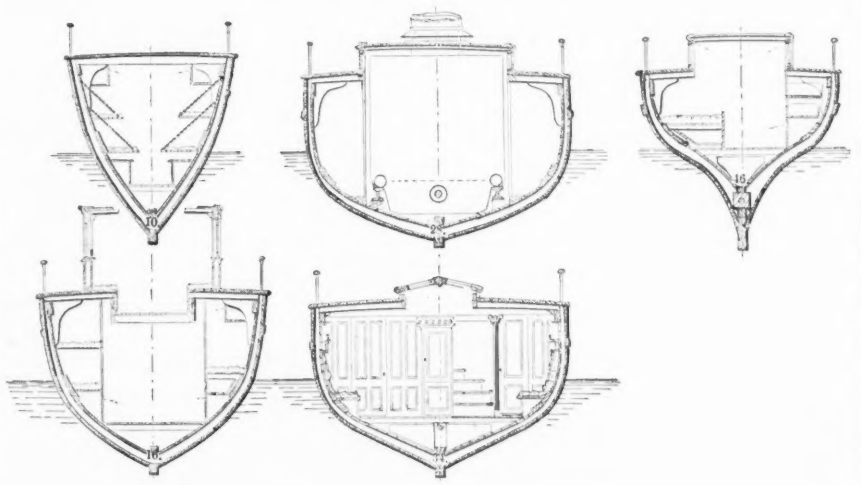
Steam Yacht Nydia.

The steam yacht Nydia, of which we give a longitudinal section, plan and cross-section, was designed for Dr. R. V. Pierce, of Buffalo, by Mr. Henry J. Gielow, of 239 Broadway, this city. The engines were designed and built by Messrs. Riley & Cowley, of Richard and Bowne streets, Brooklyn, N. Y.; the condenser was furnished by the Wheeler Condenser and Engineering Works, 93 Liberty street, this city; the boiler was built by E. E. Roberts, 18 Cortlandt street, this city, and the hull was built at H. C. Wintringharm's yard, at Bay Ridge, N. Y.

The engine is a direct-acting inverted compound engine, high-pressure cylinder 11 inches diameter; low-pressure cylinder 22 inches diameter; and stroke of pistons 15 inches. The high-pressure cylinder is provided with a piston valve 6 inches diameter, steam port area 10 square inches; for the low-pressure cylinder, a D slide valve is used, length of ports 15 inches, steam port 1⅞ inches wide, exhaust port 3⅜ inches wide. The valves are worked with an ordinary link motion, with the exception that one of the links has an adjustment by which the cut-off in the low-pressure cylinder can be regulated independently of that in the high-pressure cylinder. Pistons for both cylinders are made of steel 2 inches diameter. Connecting rods of wrought-iron, 3 inches diameter at large ends, and 2¼ inches diameter at the small ends. Crank-shaft, crank and crank-pins of steel forged in one piece; main journals 4½ inches diameter; lengths, 7, 10½ and 10 inches; crank-pins 4½ inches diameter by 4½ inches long. Line-shaft of steel 4¼ inches diameter, covered with composition at stuffing-box and stern bearing. The shaft is made in three lengths; the outboard piece is 21 feet 6 inches long; the intermediate and forward pieces each 14 feet long; couplings of cast-iron disks, and fastened together with six steel bolts 1 inch in diameter. Thrust bearing is fitted with a cast-iron box containing phosphor bronze thrust rings, and is provided with suitable oil reservoirs and set-screws for adjusting the thrust rings for wear. Two spring bearings for supporting the shaft are placed between the thrust bearing and engine. The stern bearing is made of cast-iron, and lined with lignum-vitæ, put in so that the end of the grain forms the bearing; length of bearing 12 inches. The hole through stuffing-box log is fitted with lead sleeve ¼ inch thick and 6¼ inches inside diameter. The propeller wheel is made of cast-iron, four bladed, 5 feet in diameter and 8 feet 6 inches pitch, with a developed area of blades of 6.6 square feet; it is fitted to shaft on a tapered seat, with fore and aft key, and a large cap outside with keeper.

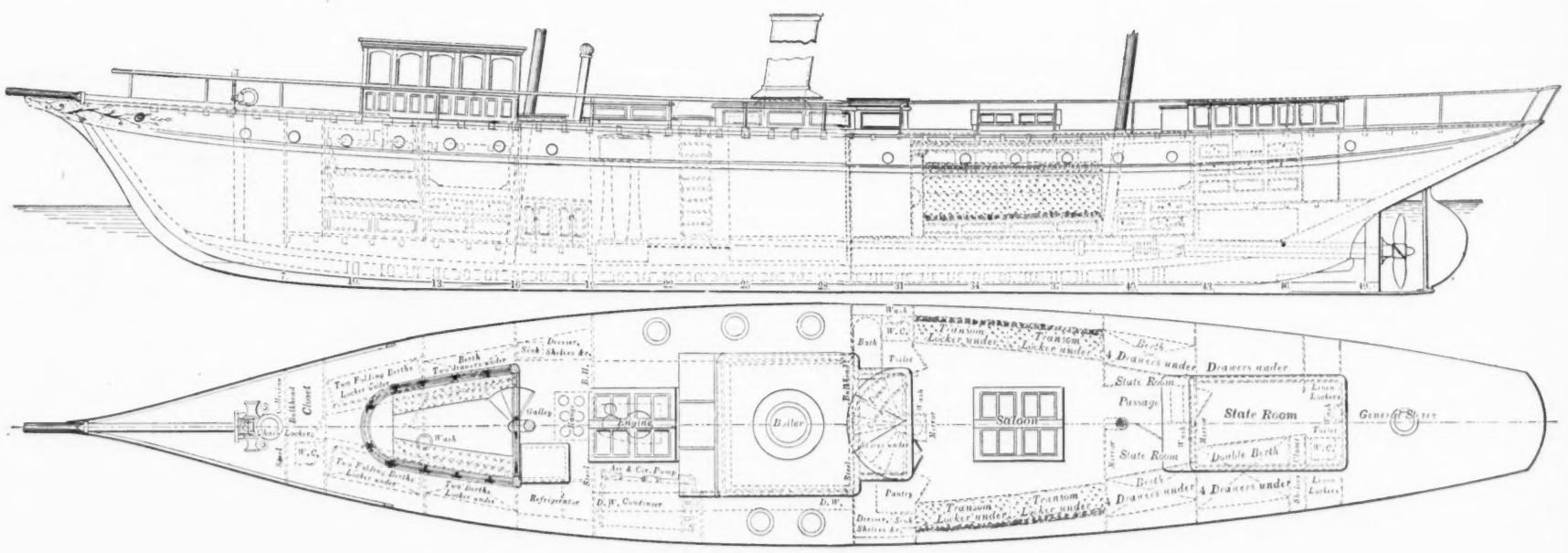


The Wheeler condenser (patented) contains about 400 square feet of cooling surface. The shell is made of hammered copper, and tinned inside; tubes of brass; these tubes are so arranged that they are free to expand and contract without the use of packings of paper, wood or similar materials; in fact, there are no ferrules, followers, washers or packings of any kind employed; plain screw joints only are used. The tubes can be easily taken out and thoroughly cleaned, as their form and the means of fastening them permit of this being readily done. The condenser made for this yacht is probably one-half the weight of the ordinary form of condenser of the same capacity.

A feed pump is connected with sea cock, hot well, and with connections to deck for washing deck and fire purposes. Hot well is of copper. The circulating pump has a branch pipe connecting with the bilges.

A feed-water heater is fitted between the engine and condenser, through which the exhaust steam will pass from the low-pressure cylinder to condenser. Valves and pipes are arranged so as to feed through heater or outside in case of necessity.

An outboard exhaust is provided for use in case of accident to condenser or pumps.



STEAM YACHT NYDIA.

The boiler is also provided with a Korting's universal injector, capable of delivering into the boiler 500 gallons of water per hour, at a steam pressure of 120 pounds.

Steam is supplied by a Roberts safety water tube boiler; it has 35¾ square feet of grate surface, and about 1,100 square feet of heating surface. It occupies a space of 7½ feet long, 8 feet wide, and 7½ feet high. It is designed for 200 pounds pressure, and is an excellent steam generator.

The boiler rests on two I beams 9 inches high, ¼ inch web, and placed about 8 feet apart.

The smoke stack is 14 feet high from top of boiler; it is composed of two shells, inside diameter 30 inches, outside diameter 36 inches; inside shell is made of No. 14 iron; outside, of No. 16 iron. Immediately above the umbrella a hinged joint is provided so as to permit the stack to be lowered to pass under bridges.

The bilge ejector has a discharge nozzle 1¼ inch diameter, with proper connections for siphoning water from any compartment at will.

All steam and water pipes are made of copper with composition flanges brazed to pipes. All live steam pipes are covered with magnesia covering, to prevent radiation.

The general dimensions of hull are as follows:

Length over all, 99 feet.
Length on water line, 82 feet 6 inches.
Extreme breadth of beam, 15 feet 9 inches.
Depth of hold amidships, 9 feet 2 inches.
Draught, 5 feet 9 inches.
Displacement, 81 tons.

Keel is made of white oak, sided 6 inches, and moulded from 8 to 10 inches. The stem is made of white oak, natural crook, and extends 4 inches forward of outside rabbet. It is joined to the keel by a scarf 48 inches long, 3 inch nibs, fastened with four yellow metal bolts ⅞ inch diameter, riveted over composition rings, and two composition spikes in each nib. The stem is bearded from rabbet to 1 inch in thickness at forward edge, and fitted with a brass cut-water.

Stern post of white oak, sided 6 inches at heel and cross-seam, 12 inches at center of shaft, and moulded 12 inches. It is secured to keel by tenon and locust treenails and a hackmatack knee; the knee is secured to stern post and keel with ⅝ inch yellow metal bolts clinched over composition rings, three pass through the stern post, and those in keel are spaced about 12 inches apart.

Forward dead wood of white oak. After dead wood of yellow pine. Rudder post of 2½ inch round iron. It extends up to the deck, and is well fastened there, as well as through the side counter timbers. The base is forged to fit a 6-inch iron shoe, extending 4 feet 6 inches forward of after end of keel, and bolted to the same with two ⅝-inch screw bolts. The iron is fastened to the keel with four ⅝-inch galvanized iron bolts; heads are countersunk so as to be flush with bottom of channel iron.

The rudder has a stock of 3 inch round iron, outside rim 2 inches square, iron drawn to 1x2 inches at after edge, filled with pitch pine, and plated with ¼ inch iron.

The frames are made of hackmatack, placed 20 inches from center to center, double framed, sided 4 inches in floors and first futtocks, and 3 inches balance of way up; they are moulded 6 inches at keel, and 3 inches at plank sheer. The timbers composing the frames overlap each other not less than two feet, and fastened with two ½-inch bolts at each butt. Floors have alternate long and short arms. A bolt of ⅝-inch galvanized iron passes through each floor timber into the keel, driven alternately 2 inches from each edge of keel. The spaces between the frames No. 19 to No. 29 are filled in solid with yellow pine about 3½ feet from center, and calked on outside and inside; the remaining spaces are filled to top of floors with Portland cement—1 part cement to 2 parts of sand. All spaces where pipes for the use of engine and boiler, and where the side lights pass through the hull, are filled in solid and calked.

Keelson of fat pitch pine 6 inches square. Scarf is 7 feet in the clear aft of keel scarf, of equal dimensions, and fastened with four ⅝-inch galvanized iron bolts clinched over galvanized iron rings. The fastening of the keelson is one ⅝-inch galvanized iron bolt passing through each frame into keel, and one ⅝-inch yellow metal bolt passing through each frame and keel, and clinched over composition rings; and secured to stem with tenon and hackmatack knee, fastened with seven ⅝-inch galvanized iron clinch bolts, three bolts through stem, and four through keelson.

The garboard and all outside plank is of yellow pine 2 inches thick. A strake below the plank sheer is 8 inches wide. No plank exceeds 9 inches in width. All plank above the water line are fastened with two 4-inch spikes, and one ½-inch through bolt; below the water line two 5-inch spikes and ½-inch through bolt, and with two fastenings to each frame in plank less than 6 inches. The bolts are clinched over rings on inside of ceiling. All fastenings are of yellow metal up to 6 inches above load water line, through bolts of copper, the remainder of galvanized iron. All seams are calked with three threads of best navy oakum and pitched and puttied above water line. Parallel to, and 2 feet below plank sheer, there is an oak wearing strake 3 x 4 inches amidships, and tapering to 2 x 3 inches at ends. Clamps of yellow pine 3 inches thick, and 9 inches wide, with scarfs 4 feet long. They are fastened to each frame in center of timber by two 5½-inch galvanized iron spikes, besides the bolts passing through from outside.

Bilge strakes of yellow pine, two strakes on each side at turn of bilge 9 inches wide, and 3 inches thick.

Ceiling of yellow pine dressed to a uniform thickness of 1 inch, and fastened with two 3½-inch galvanized iron spikes to each frame.

Beams are of white pine, moulded 5 inches at center, and 4 inches at ends, let into the clamps ¾ inch, and worked with a crown of 5 inches amidships. They side 4 inches, and are fastened to clamps with one ⅝-inch bolt. Each beam is connected to frames by a hanging knee at each end, except in saloon, where they are dispensed with.

Deck planks of white pine 1¾ inches thick, and 1¾ inches wide. The lower deck of white pine 1 inch thick, and 4 inches wide, tongued and grooved. Plank sheer of white oak 2½ inches thick on outside, and 1¾ inch on inside, and 9 inches wide.

Rail of mahogany extending all around the vessel, supported by ⅞-inch galvanized pipe stanchions, 24 inches long, and spaced about 5 feet apart. The space between the rails and deck is fitted with rope netting. There are three bulkheads made of plate steel ¼ inch thick butt-jointed, plates about 36 inches wide, and running in one length from floors to deck beams. The lap-strips are of T steel 3 x 3 x ¼ inch single riveted, with canvas soaked in paint placed between joints, to make them water-tight. Each plate is reinforced with a T 3 x 3 x ¼ inch. One of the bulkheads is a "collision" bulkhead close up to the stem, another is just forward of the engine, and the after one is just abaft the boiler.

The coal bunkers extend along each side of engine-room, as shown in the illustration. There are fourteen side-lights or air ports on each side of vessel, of the "Monitor" pattern, glass light 8 inches clear in diameter.

There are two water tanks in hold under saloon, about 12 feet long; one tank under the owner's state-room about 6 feet 6 inches long; and two tanks aft of owner's state-room, 3 feet long. All are made of ¼-inch iron galvanized, and provided with manholes, vents, filling and connecting pipes and suitable perforated partitions.

Heaters are fitted in pilot-house and saloon, connected to the boilers, and have all the necessary reducings, valves and fittings complete. Masts are of white pine; foremast from deck to cap 29 feet, and 8 inches diameter. Mainmast from deck to cap 30 feet, and 8 inches diameter. Fore-topmast 18 feet long. Main-topmast 21 feet long. Fore-gaff of spruce 16 feet long; main gaff of spruce 17 feet long; both have a diameter of 5 inches. White pine bowsprit 6 inches diameter. Standing rigging is of the best quality of charcoal steel wire rope galvanized. Fore shrouds, two on each side 1⅝ inch circumference; main shrouds, two on each side 1½ inch circumference. Fore and main stays 1½ inch in circumference; topmast stays 1 inch in circumference.

Sails and awnings are of cotton canvas. One foresail of No. 5, one mainsail of No. 5, one fore-stay sail of No. 4, one main-stay sail of No. 4, and one jib of No. 4 cotton canvas. Awnings are of No. 7 canvas, and extend full length of vessel, supported by awning stanchions. There are two mahogany skylights; one over the main saloon, and one over the engine-room; length 5 feet 9 inches; width 4 feet 9 inches over all, and glazed with double thick ground white glass, protected by ⅝-inch brass tubes.

State-room trunk is 10 feet long, 6 feet 6 inches wide, and 2 feet high. The sides have sashes fitted with ground glass lights, hung with brass hinges on lower side, and fitted with brass quadrants or rods and set-screws to support them at any desired inclination. All visible wood work is of mahogany, except deck, which is of white pine ⅝ inch thick, tongued and grooved.

Forecastle is 9 feet long, extending full width of vessel, fitted with four folding berths 6 feet long and 24 inches wide, with lockers under, along each side.

The officers' quarters and mess-room are immediately aft of forecastle, and extend from side to side of vessel, fitted with fixed berths; one on starboard and two on port side. All visible wood work is of ash, the balance white pine.

The galley is situated between the officers' quarters and the engine-room bulkhead extending full width of vessel, and 5 feet fore and aft. All interior visible wood work between collision bulkhead and engine-room bulkhead is of ash, filled and rubbed down and finished with two coats of dammar varnish.

The cabin pantry is on the port side forward of the saloon, and utilizing all space under the companion-way. It is fitted with lockers below, and racks, shelves and hooks, etc., above.

Bath and toilet-room is located to starboard of companion-way. It has connections with boiler for heating water, and has all necessary pipes, nickel-plated valves, faucets, etc. The water is discharged into a 5 inch pipe connected directly with bilge ejector, so that the water can be blown overboard without getting into bilges. All wood work of ash. The saloon extends the full width of vessel, and 12 feet 4 inches fore and aft, with transoms 18 inches wide along each side, with lockers underneath. Nickel-plated rods are provided to receive curtains for dividing the saloon into state-rooms. The whole interior is of mahogany panel work and mouldings. At the forward end amidships is a Mott's folding wash-bowl, enclosed in a handsome mahogany cabinet with a door having plate mirrors on inside and outside, each 18 inches by 36 inches. The space between deck beams is fitted with Lincrusta Walton. A passage leads from saloon to the owner's state-room; it is 2 feet 6 inches wide. On each side of the passage is a small state-room, and fitted with one berth 27 inches wide and 6 feet long, with four drawers under each.

At the after end of passage, and reached by two steps, is the owner's state-room, extending full width of the vessel, and 7 feet fore and aft. The port side is fitted with a double berth 4 feet by 6 feet, with four drawers under, and a small closet and shelf at hand. On the starboard side there are drawers and toilet stand. A plate mirror 24 x 36 inches is built in the bulkhead on forward side. Abaft the state-room there is a toilet-room. All wood work is of mahogany.

The steam yacht is expected to go in service the early part of June. She was built with great care under the immediate supervision of her designer, Mr. Gielow. Only first-class workmanship and material have been allowed to enter into her construction, and will undoubtedly prove herself to be a comfortable and fast boat.

A Thing to Think Twice Over.

To our own mind the thing to be sought for is to make Brattleboro what it ought to be and may be, as a place of residence, and as a resort in summer time for city residents. Some big manufacturing industry would add much to our wealth and population, but it is a serious question whether it would not so change the character of our population as to rob the town of what is now its peculiar charm. It is impossible that any other industry should do for Brattleboro what the Estey factories have done. An equally sure source of income would be found in permanently attracting here the hundreds of summer visitors that would surely come if our natural advantages were properly made use of; and the town would make no loss, but rather a gain, in the spirit of refinement, of moral excellence and general culture, for which it is already noted. The money income would be large, and there would be an overflow into our surrounding country which would be mutually helpful.

The foregoing, with the exception of the title, is taken from the *Vermont Phœnix*, one of the most influential and conservative papers published in a State noted for the hard common sense of its citizens. It reminds us, just at this writing, of two instances that occurred some years ago. One was that of a town in N. Y., through which a railroad was to pass. The railroad company was anxious to establish its shops in that town. It was the most natural location; but the citizens were, almost to a man, opposed to it. The argument was that the town was one of residences for wealthy people, and that the influx of "railroad men" incident upon the establishment there of shops and roundhouses, would disturb the "elect," to the detriment of the financial and selected interests of the town. The opposition was so great that the shops were built elsewhere, and this town, that objected to the "dirty, low mechanicals," would have "given its boots," within ten years, if it could have reversed its decision. But the goose of the golden egg had gone, and the town has languished through thirty years, its citizens always deploring their peculiar exclusiveness.

Another instance is that of a town in the same State that seriously contemplated a change of name because that name savored of mechanical operations. This was thirty years ago, and to-day this same town is trying by every laudable means to locate mechanical industries.

The simple fact is that there are no better inhabitants of any town than skilled mechanics. As a class (if the term is allowable) they are sober, honest, industrious and gentlemanly; and they bring money to a town, and spend their earnings for the benefit of the town—not for two or three months of the year, but for twelve months of the year. They discharge their honest obligations both financially and morally.

It is hard to conceive of a more God-forsaken place than one that depends upon "summer residents." Plenty for three months, and poverty for the rest of the year. The inculcation of a system of chicanery as a matter of life and death. A pauper population for the greater part of the year unless robbery has been practiced.

If a town has peculiar advantages for summer residents it is perfectly legitimate that these advantages be worked as auxiliary to its prosperity; but if these alone are depended upon, then, unless gambling operations and their concomitants can be relied upon to bring in money when summer attractions are eclipsed by winter, the condition of that town is not enviable. There are places so exclusive that everything savoring of honest labor is frowned upon, but we never heard of such places doing anything to help the world along. They sit on the wagon and depend upon others to trundle them ahead—not a very satisfactory thing to do.

Apropos of the damage done by lightning to the big Clark chimney at Newark, and the wide public interest which has been felt in the daring method of its repair, we have heard of a much more singular occurrence, which we believe has never yet found its way into print.

About six months ago, one of the many stacks at the Barbour linen thread works, at Paterson, was struck by lightning in the most peculiar manner. The chimney is a square brick structure about one hundred feet high. The electrical bolt struck it about thirty feet from its summit, cut it clean in two horizontally, so that the upper section was lifted clear of the remainder, and dropped back into place so squarely that it remained balanced and standing, though swaying a little in the strong wind. Not wishing to attempt to rebuild the chimney during the winter, the company caused a scaffolding to be built, and a broad iron band to be rigged around the fracture, a little distance outward from the chimney, forming a trough into which cement was packed, thereby rendering the chimney temporarily safe. During the summer the stack will be taken down to the point of fracture and rebuilt.—*The Dry Goods Economist.*

A contemporary has this head-line: "Is My Idea Worth Patenting?" Generally speaking, we should say no. If less "ideas" were patented it would be to the pecuniary advantage of patentees, and no loss to the community.

An elaborate system of protection against fire is to be installed at the Brussels Theater de la Monnalie during the summer holidays. An immense water tank will be connected with a number of small taps placed all over the building. When either of these taps is turned the water will run into a series of pipes playing upon the stage and will automatically bring down the iron curtain, ring alarm bells and light electric lamps in all the passages, so that the audience may find their way if the gas fails.

A new alloy is described for use in the place of steel in the manufacture of various parts of watches, such as the balance wheel and hair spring, so as to obviate the disadvantages which follow on their magnetization or oxidation. The composition of the alloy is as follows: Gold, 30 to 40 parts; palladium, 30 to 40 parts; rhodium, $\frac{1}{10}$ to 5 parts; copper, 10 to 20 parts; manganese, $\frac{1}{10}$ to 5 parts; silver, $\frac{1}{10}$ to 5 parts; and platinum, $\frac{1}{10}$ to 5 parts. The copper and manganese are first of all to be melted, and the other metals afterwards added, or the whole of the constituents may be placed in the crucible at once, with the manganese at the bottom.

The many fires that are started by sparks from locomotives and mill chimneys indicate that the spark arrester has not been brought to the degree of perfection that is desirable, or that it is not so generally in use as it should be. There have been many inventions of this kind, but there is yet room for genius to produce a device that will accomplish the end sought and line the pocket of the inventor with ducats—provided the invention would be adopted. Fire is perhaps the greatest enemy of the lumber business in all parts of the country, and it is the first thing to be guarded against.—*Northwestern Lumberman.*

Ice-making Machinery.

In our last week's issue we illustrated a 150-ton refrigerating machine built by Frick Company, engineers, Waynesboro, Pa., and we now present additional details of the same machine.

Fig. 4 is sectional view of the gas compressor pump; Fig. 5, details of suction valve and pump piston; Fig. 6, by-pass arrangement; Figs. 7, 8 and 9, indicator diagram from a 100-ton machine by same builders.

Referring to Fig. 4, the construction of the compressor pump is clearly shown; it possesses some novel and desirable features. The pump is single-acting, and is provided with a safety head, which makes it possible to perfectly expel the full charge of gas without resort to the use of oil or danger to the machine. This is accomplished by properly adjusting the piston, so that, on the completion of the upward stroke, no clearance space is allowed between the valve and the piston.

The gas discharge valve is centrally located within the safety head, and is of the noiseless cushioned type. A commendable feature, that is much appreciated by engineers, is the arrangement of discharge opening on side of pump dome, which, while it leaves the cooling jacket unobstructed, renders it possible to adopt a convenient construction not usually found; namely, by simply removing the pump bonnet or head, the valves are exposed without interfering with any other joint. The entire valve mechanism can then be lifted out and replaced with a duplicate in a few moments.

Fig. 5 shows the construction of pump piston and removable cushioned-balanced suction valve, which is made interchangeable. The valve itself is of large area, and affords an excellent arrangement for securing noiseless and prompt action with the least resistance to flow of gas to the pump.

Fig. 6 is an arrangement of by-pass pipes and valve, which are a noteworthy addition to ammonia pumps, as by their use the expensive gas, which would otherwise be wasted, endangering life and property, when making examination of various parts of the pump or apparatus, is saved, much to the comfort and satisfaction of those in charge. By operating this by-pass system the gas may be withdrawn from any part of the ammonia apparatus, and stored in any other part; also the pumps themselves may be exhausted, and gas taken from the compressor side of the system and stored in the suction side. Its application and uses may be understood upon studying the drawing.

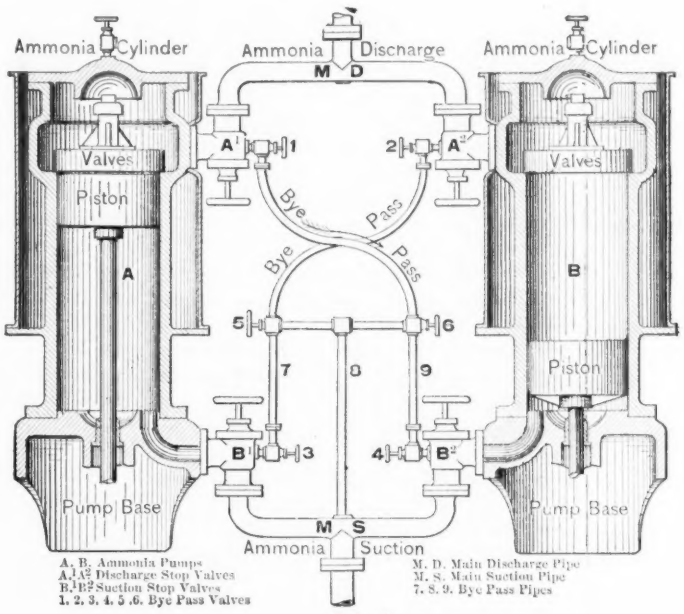


FIG. 6.

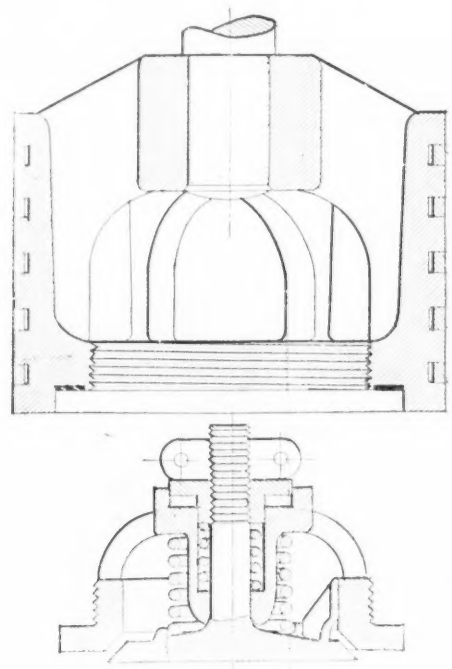


FIG. 5.

The indicator diagrams shown are from machine in use at the Armour Packing Company's premises in Kansas City, and were taken simultaneously, that is to say, several indicators were used, and, at a signal, cards were taken at the same instant. The record, therefore, graphically represents the state of affairs in each of the steam and gas cylinders during one revolution of the machine, and are valuable for determining the power required, loss by friction, etc. They represent very perfect action. The notable features of the diagrams are, first, the reception of a full charge of gas, shown by the regularity of the back pressure line. Second, prompt action of the suction valve. Third, complete expulsion of the charge. Fourth, remarkably smooth pump action. The engine was exhausting under considerable back pressure, due to a loaded exhaust pipe valve. The engravings so nicely illustrate the various details that little need be said.

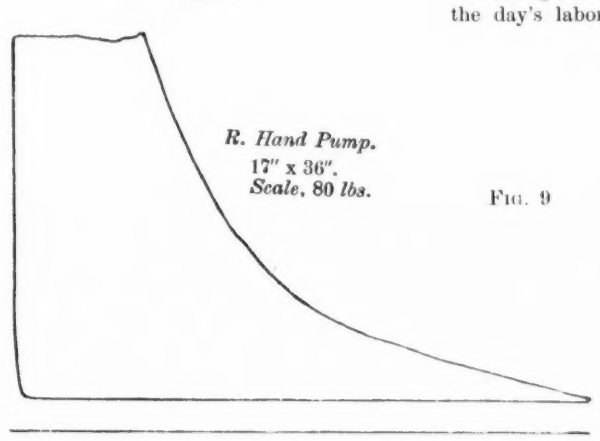


FIG. 9

FIG. 7.

FIG. 8.

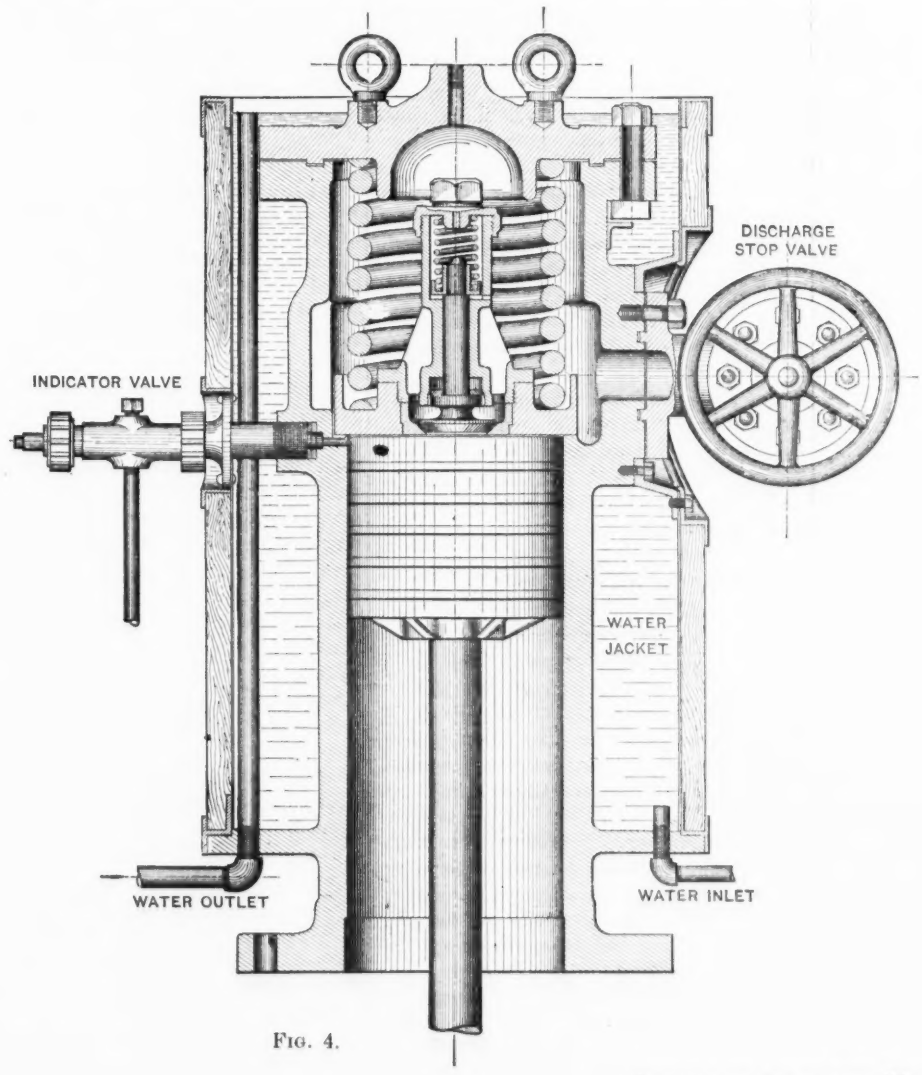


FIG. 4.

DETAILS OF ICE-MAKING MACHINERY.

Mark Them.

News has reached us from various portions of the country many times during the past year that in certain localities there exist firms who make a practice of continually working their moulders eleven, twelve, and even as high as fourteen hours a day, occasionally without making any extra allowance for overtime.

That this is rank injustice is a fact that admits of no argument. It is worse. It is theft. It is a species of dishonesty that is all the more contemptible because it is carried on through a sort of terrorism that says to the man who protests, "If you do not like it you know what you can do."

The moulder is placed in a peculiar condition. His trade is unlike that of any other. He is compelled to remain until his work is poured and the "heat" is over. In other trades similar pretexts for retaining a man do not exist, and can therefore not be taken advantage of.

It is the desire of the Brotherhood before any move is made towards shortening the standard of the day's labor, to bring about something of a reformation in this respect where it exists and we have the power to resist. Something has already been accomplished in this respect in one or two places, and we have others in view where the attempt will shortly be made. Such a system is simply a fine species of slavery, and where a business cannot be carried on without resorting to such unfair methods the community will be better served by its complete extinction.—*Machinery Moulder's Journal.*

It is the Way of the World.

Every one who travels between New York and Brooklyn on the Fulton ferry-boats is familiar with the appearance of Abraham Sweatt Young, the blind newsman, who, rain or shine, for the last forty-nine years has sold afternoon papers in the ferry-house on the New York side.

Many will feel a thrill of regret to learn that he must leave his stand, never to return, because the Union News Company has spread its tentacles, and by paying $25,000 for the privilege has acquired the sole right of selling newspapers, magazines and periodicals in the Fulton and other ferry-houses on the East River.

Young is seventy-five years old. He was totally blind before he began to sell papers for a living, having lost his sight and being otherwise disabled by an explosion in 1840 on the steamer Rushlight, of which he was fireman.

Then he had a wife and family, and to support them he began to sell newspapers.

Misfortune pursued him. His wife died, and then his children went one by one until only one boy was left. The latter is now thirty-five years old.

He has devoted his life to the care of his afflicted father, leading him to and from their humble home, a single room in a boarding-house on Prospect street, Brooklyn, and helping him daily in disposing of his papers at the ferry-house.

There are two stands in the ferry-house leased by George J. Swaine, who has been there since 1860. He paid $500 per year for the privilege, and, though his profits have been little enough, he has never asked to have old man Young, who pays nothing for his privilege, removed.

On the contrary, he and his assistant, William Grogan, have done all in their power to assist him, and many a night the old man would have been "stuck" on his papers but for the kindly watchfulness of Swaine and Grogan.

The blind man sits on a bench, mutely holding his papers forth, at one door, and his son at another. Between them they have never averaged more than $2 per day profit, and now, in his old age, Young is penniless and almost friendless.

He has got to go on the 1st of June, because the Union News Company will brook no rivalry.

Assistant Superintendent Smith, of the Ferry Company, was asked this morning if nothing could be done to keep old Young in his stand.

"Nothing," he said coldly. "The Union News Company has paid for the privilege, and on June 1 Young must get out. It is a matter of business, not sentiment," he concluded.—*N. Y. Sun.*

LETTERS FROM PRACTICAL MEN.

The Corrosion of Gauge Glasses.

Editor American Machinist:

A great deal has been said and written of late concerning the corrosion of gauge glasses, such as are used on steam boilers to indicate the water level, and opinions are many and greatly at variance with each other as to the cause of the wasting away of the glasses. The theory of the water of condensation running down the inside of the glass, carrying with it small particles of iron rust and other solid matter, thus producing a grinding action, is nothing more than theory, for the reason that gauge glass fittings may be used for many years, and yet not show the least evidence of corrosion or wasting away that would be necessary in supplying rust particles to assist in grinding away the gauge glass that may be attached to them.

Neither is asbestos the infallible remedy for gauge glass corrosion, as some would have us believe; nor is the rubber ring packing the all-destroying element in connection with the use of glass tubes as water indicators; while rubber packing will hasten the wasting of the glass upon the outside of that portion protruding through the packing into the steam space, it at the same time will not injure that part of the glass surface where the rubber forms a joint, unless the packing is allowed to leak, neither does it have any effect on the inside of the glass.

As proof of the latter assertion, I submit the upper half of two glasses selected for the purpose of trying the experiment; on the 22d of last January these glasses were applied to two separate boilers working together in the same battery, and all their working conditions were precisely the same in every respect. No. 1* was packed with rubber rings, while No. 2 was packed with carefully selected asbestos, well oiled, and the fittings thoroughly cleaned. They were removed a few days ago, having been used a little over three months. No. 2, the glass packed with asbestos, is wasted away to a greater extent on the inside than No. 1, which was packed with rubber; the glass No. 2 protruded through the asbestos about the same distance that

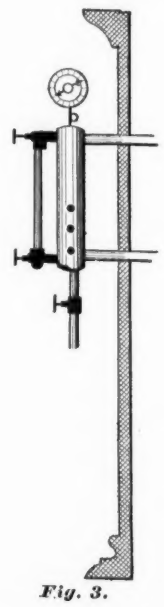


Fig. 3.

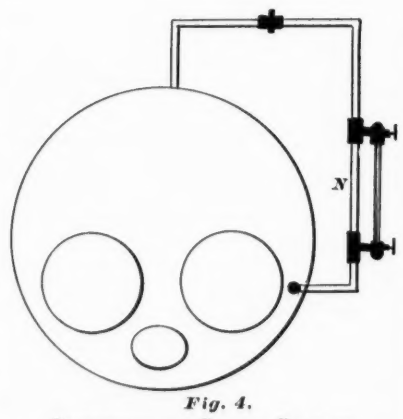


Fig. 4.
CORROSION OF GAUGE GLASSES.

Fig. 1 did through the rubber, and there is barely a perceptible wasting on the outside of the asbestos packed glass. These glasses were supported in fittings arranged as in Fig. 3, the steam and water connections passing through holes cast in the boiler front for that purpose; the water connection tapped directly into the boiler head, and the steam connections tapped into the top of the boiler shell near the end passing down through the masonry, and out as shown. This produces but little condensation, and that little is being continually caught in the chamber to which the glass is attached before reaching the glass. The condensation passing down through the glass is condensed in the fitting immediately above and in the glass itself, and in amount is very small.

The smaller the amount of condensation passing down through the glass the more rapid will be the wasting away of the glass, for the simple reason that the smaller the quantity of condensation the hotter will the water be. I have worked gauge glasses in fittings similar to Fig. 3 for two years before they would break; but the steam pressure never exceeded 40 pounds, while the glasses 1 and 2 were worked under a pressure of 90 pounds.

* Our correspondent refers, in Nos. 1 and 2, to the glasses sent us, of which it is not practicable to produce cuts that will materially aid in the description.

As further proof that the larger the quantity of condensation passing down through the glass, the less will be the wasting away of the glass, I will relate some experience of twelve years ago. The glass was supported in fittings similar to Fig. 4, all of the condensation passing down through the pipe, which was one inch, except what little was condensed immediately above the glass in the fitting.

The glasses would last on an average about four months. The short piece of pipe *N* was removed, and a piece of round iron substituted, the openings in the fittings being ample to carry all condensation back without distorting the glass as an indicator; it worked like a charm; the water could be plainly seen continually running down the inside of the glass, and the wasting away of the glass almost entirely disappeared, so much so that the glasses would last from twelve to eighteen months.

It is often the case that glasses are supported in fittings similar to Fig. 4, except that the steam connection is tapped into the steam drum, and the water connection tapped into the mud drum, thus making the pipe always from twelve to twenty feet, and often more in length, the longer the pipe the greater the surface exposed; likewise the greater the condensation, consequently the lower will be the temperature where the glass is located.

The life of a gauge glass can be greatly prolonged, if those having the care of them will learn the length of time they last before being destroyed by corrosion, carefully remove them in time, clean and replace them carefully with the good end up; they will then last nearly or quite as long as a new glass.

S. A. SMITH.

The Swinerton Locomotive.

Editor American Machinist:

I have been making a little mental arithmetic problem to fit the Swinerton polygonal wheel. Suppose the wheel is six feet in diameter, and the flats two inches wide, how much farther from the center of the wheel are the corners than the center of the flats?

Suppose the locomotive is going at a good rate of speed, will the wheel not tiptoe along the rail, part of the time, not in contact therewith, and free to buzz round without doing any hauling business?

It seems to me that the first effort of any well-conducted and sensible locomotive wheel would be to wear off those monstrosities, and get down to business again.

The saddest reflection, caused by such departures from "the well-known laws of mechanics and friction," is the fact that such things sooner or later disgust capital, and make it over-shy where an invention of real merit is presented.

Two bodies cannot "friction" each other much when they are not in contact.

BENJ. F. WILSON.

A Correction.

Editor American Machinist:

In your issue of May 22, '90, Mr. B. F. Spalding, at top of page six, first column, says: "And the red prussiate (ferrocyanide, or chromate of potassium) stands firing longest."

This is a mistake. The red prussiate is the ferricyanide of potassium, not the ferrocyanide. Chromate of potassium is an entirely different substance, not only in chemical composition, but also in appearance. The chromate crystals are of a bright red color, while the red prussiate crystals are very deep red, with a greenish cast.

MARSHALL FROST.

[The error of substituting ferrocyanide for ferricyanide is a typographical one. Mr. Spalding wrote ferricyanide.]

It has been pretty well demonstrated that the ice dealers in New York and vicinity have been enormously profited by the advance in the price brought about by an alleged scarcity. It is pretty generally known what the wholesale dealers charge for ice, and consumers know, to their sorrow, what the local dealers charge them. Now, in view of the well-known facts in the case, why the local icemen should cut down the wages—or seek to do so—of their employes, is a mystery. Does one gain make us mad for further gains? It looks like it in the instance of the ice dealers.

Practical Details of Case-hardening.

BY B. F. SPALDING.

SECOND PAPER.

BOXES — PACKING — FURNACES — FUEL — PETROLEUM — HEATING — THE TELL-TALE — RE HEATING—TANKS—COOLING IN WATER —IN OIL.

The boxes designed for heating articles in, which are to be case-hardened, may be either of wrought or of cast-iron. Those made of wrought-iron are more expensive, unless in such cases as where only one of a special size is wanted, when it may be cheaper to make it of wrought iron than to make a pattern for casting. Wrought-iron boxes may be either welded or riveted, or both. Repeated heatings to a red heat are hard on welds. Wrought-iron expands more, and hence warps, more than cast-iron; boxes made of it can be knocked back into some shape while they are hot, while, under the same treatment, cast-iron boxes would be knocked out of all shape. Wrought-iron makes the most durable boxes.

Next to wrought-iron in endurance, when subjected to repeated heatings, are boxes cast from malleable iron scrap. These will last to take three or four times as many heats as can be taken with common cast-iron pots. There was a time when malleable iron scrap could hardly be given away, but it is found to be valuable for all kinds of castings which are exposed to much heat, those used about furnaces, or for grate bars, stove linings and kindred purposes. Boxes follow the general rule of iron exposed to fire, and warp with the convex side towards it. They bulge out. To lessen the tendency to do this as much as possible, they are made sometimes with a rim at the top, on the inside; but when the work is to be tipped out this rim would interfere with its free delivery. In such cases it may be given slope enough so that the work will not catch, or, if the work is liable to choke, the rim may be turned outward.

It is of importance to have good arrangements for handling the boxes, and these can easily be made, for it is not desirable to have a great variety of sizes; two or three will generally suffice.

When heavy work is to be dumped from them, the boxes may be made with a short trunnion at each end, which can be caught with a double hook, from a crane, in which they can turn when the box is tipped over, or the boxes may be made to handle with tongs, or porter bars, swung to the crane.

A box for light work, say up to thirty pounds, may have on one end a round stud an inch and a quarter in diameter, projecting three inches, and having a good fillet where it joins, and by this it can be handled carefully with tongs, but the way they will drop off when they are nearly white hot, and get a little jar, is often surprising, and always aggravating.

The old way for somewhat larger boxes was to make the patterns of three-eighths stuff, with a rim around the upper edges as shown in Fig. 1 (page 5). To handle these, the fork, which is also illustrated (Fig. 2), was used. A pair of long tongs was also provided to handle them in the fire.

The largest boxes I have seen used for case-hardening were 30″ long, 18″ wide, 6″ deep. They were not used for dumping the work; it was taken from them, piece by piece, with tongs. Boxes 9″ x 6″ x 4″ are very handy for small work. Sizes as large as 12″ x 8″ x 6″ can be handled by a strong man. Probably most of the case-hardening is done in boxes within these limits.

The carbon-yielding material in which the work is to be packed—by some termed brasque—is to be selected for its fitness. The kind is determined by the quickness of the process, and depth of hardening required; charred

leather for from 1 to 3 hours; fine, and then coarser granulated bone, as the period increases, from 1 to 24 hours; and hard wood charcoal for longer periods, with mixtures of these for any gradations wanted.

In packing, put a layer of the brasque in the bottom of the box, deep enough to form a good cushion for the even support of the work when it is yielding hot, allowing, also, for what will burn away; half an inch will do for light work, larger work requires more. Pack the work on this, so that the pieces do not touch each other. Where much extent of surfaces come next to each other, the space between must be increased, to allow for more packing. In hardening round shafts, 1⅛″ diameter, it was noticed that when they were packed with less than ¼″ of brasque between them, the contiguous sides were perceptibly softer than other portions. 1⅛″ square shafts, packed with their flat sides towards each other, would require half an inch between them. Not less than half an inch should be allowed between the work and the sides of the box; if the fire is to be driven hard, more should be allowed. Fill in all around the work with the packing material. Although the pieces, when cold, are stiff, they must be packed as though they were as flexible as lead, for the heat will reduce them to that condition. There should be an inch and a half of packing between the work and the cover; an inch of this may be of old material which has been used. The cover, if of iron, should be luted on with clay. Good clay covers can be made by the addition of salt, or by mixing the clay with a large proportion of old bone.

In places where case-hardening was only done occasionally, I have seen very good results, quite conveniently attained, by the use of a furnace, much like the Bradley heating furnace. The arch was raised on brick, high enough to admit the boxes. These sat on tile laid across the center, and the flame came up through the hopper holes, which are on each side. A tile closed the front, and another the back, with the exception of an opening, which led to the flue. It was fed at the mouth. When it is convenient to heat with charcoal, the furnace may be simply a walled-up brick box, with a grate 10 inches from the bottom, the walls above being a foot high. The boxes may be set on bricks which raise them above the grate. A passage at one end is given to the chimney; the fire is lighted, and covered over with sheets of iron, which creates a draught through the grate.

A fire can be made on a blacksmith's forge, which will heat a good sized box very well if charcoal is used, or some wood and coke mixed makes a very good fire. The furnace described and illustrated in the AMERICAN MACHINIST, Feb. 25, 1882, as the one used by the Worcester Screw Co., was found to heat satisfactorily with soft pine wood, with chimney draught; but with hard coal it required forced blast. It is a good furnace. The furnaces shown in the AMERICAN MACHINIST, April 22, 1882, and June 23, 1888, are designed for constant use, and continuous heating of large quantities of work. The Brown & Sharpe annealing furnace illustrated May 12th, 1883, altered into a case hardening furnace, and illustrated Jan. 19, 1884, is so complete in its details as to leave nothing more to be desired.

The furnace shown in longitudinal and cross-section (Figs. 3 and 4) requires for its construction 12 tiles 28″ x 12″ x 4″—five of these are cut as shown in Fig. 5 for floor tiles for the heating chamber—3 tiles 28″ x 9″ x 4″, and one, 14″ x 12″ x 4″, and about 1,500 fire bricks, besides the foundation, and about 10 feet of inch-square iron for grate bars; this is all the material required for its simplest form. Some additions to the expense may be profitably made, in the way of clamping bolts and bars to hold it together; and iron sheathing, all around, will save fuel by preventing the dispersion of heat.

It is evident to every one who has paid any attention to the matter, that there can be no better fuel, for the purpose of getting and maintaining the proper temperature around case-hardening boxes, than petroleum or gas. The Worcester experiment is one of many which show conclusively that a concentrated heat is not as desirable as one more diffusive; therefore, some methods of using these fuels which have not produced good results in forging, where high heats for welding were needed, may still be peculiarly adapted to this purpose. I have not noticed any reference to such use, in the advertisements of the various concerns engaged in promoting it. Things in its favor are, that the first cost of a furnace for the purpose would be less. It can be better regulated. It is not necessary to consume a great amount of fuel to heat the fuel to make it burn. When the use of the fuel is no longer needed, it can be stopped at once. The temperature of the furnace, never being excessive, the furnace will be much more durable. The time of the workman can be more profitably employed than in shoveling coal and ashes.

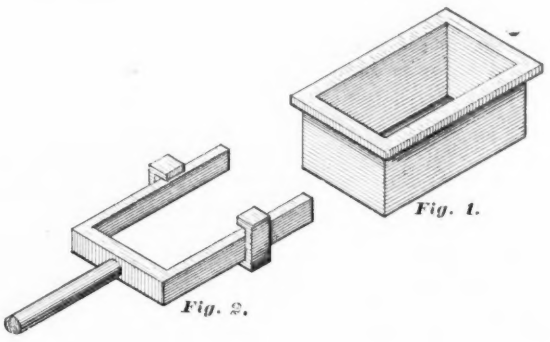


Fig. 1.

Fig. 2.

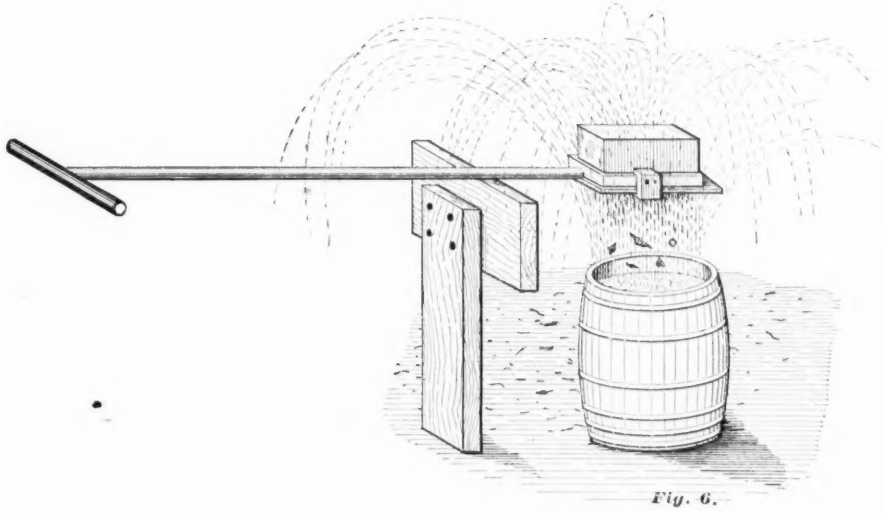


Fig. 6.

Fig. 5.

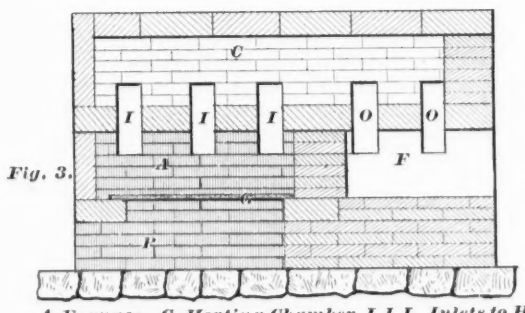


Fig. 3.

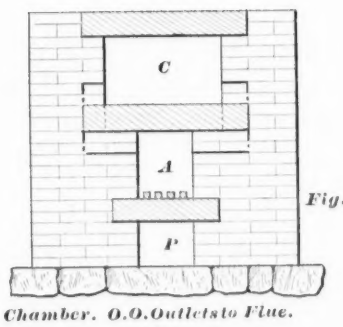


Fig. 4.

A. Furnace - C. Heating Chamber. I. I. I. Inlets to Heating Chamber. O. O. Outlets to Flue. F. Flue. G. Grate. P. Ash pit.

CASE-HARDENING.

In case-hardening for hardness, the work must be heated to a good cherry red, and kept at that heat until everything in the box is of a uniform temperature. This may possibly be accomplished in an hour, and the pieces can then be taken out and quenched in cold water. The surface will now be hard, but the depth of this hardening will be but slight. The thickness of the hardened case will increase in proportion to the length of time the box is held at this heat. When bone is used, it should be kept in mind that "the action of the phosphate of lime upon animal charcoal is to isolate and individualize the carbon, and this makes the carbon particles specially and powerfully active." If the temperature is not raised to so high a degree as to activate the phosphorus, it is helpful, but if this happens, carbon will be exhausted from the bone, and the phosphorus, set free, will be absorbed by the work, which will become brittle-hard, clear through. In case-hardening for color the same remarks apply, only this, in addition, that the work must not be exposed to the air.

The time of heating must, therefore, vary according to the size of the work, the intensity of the fire, and the depth of the hardening required. The Rogers & Hubbard Co., of Middletown, Conn., manufacturers of granulated raw bone, offer a good suggestion to those who have had but little practical experience in heating for case-hardening. They recommend the use of a "tell-tale." This is a piece of round iron, as near the size of the work as possible, put down through a hole in the cover, above which it slightly projects. When it is thought the work has been in long enough, the piece can be taken out with tongs and cooled in water, to determine whether the work will harden to sufficient depth. A few such tests will give sufficient experience to enable the workman to trust to his judgment. The practice appears to be a very useful modification of one used in making blister steel by the similar process of cementation, in which the progress of the operation is determined by the examination of "trial bars," which are withdrawn from the pot, from time to time.

If it is found that a certain time, say 12 hours, of heating, is necessary to convert the surface of the work into steel, to a sufficient depth, and that the iron is of such nature that its stability is dangerously impaired by the process, it is likely that the carbon is too early exhausted from the brasque, and that the phosphorus has become active. To remedy this evil, in such cases, the piece may be heated six hours, and allowed to cool, and after being re-packed with fresh brasque it may be re-heated six hours longer. The steel will now be found to be of nearly the same depth as that acquired by the twelve hours heat, and to be of better quality to resist fracture by flexure or shock, although not necessarily of greater tensile strength.

Bright colors are lost by long-continued heats. If they are desired on work which must be deeply case-hardened, they can be secured by subjecting the pieces to two separate heatings, the first one being long enough to carbonize the surface to a sufficient depth, and the second, only long enough and hot enough to produce good and durable coloring. As the quick cooling of the piece, after it is carbonized, does not add to the carbon, but only changes its condition, the piece may be left soft after the first heating, and in this state the surface may be finished, ready to receive the case-hardening for colors. A low heat will suffice for this purpose, and will, by cooling, give as great thickness of hardening as the first heat would have given if it had been quenched. By this process, the quality of both the iron and steel are improved.

When a box of case-hardening has been sufficiently heated—whatever length of time may have been required for the purpose—it is taken from the furnace and allowed to set a few moments, until the top and sides lose their bright redness; the cover may then be removed, and after this the work is got into the water as quickly as possible.

The primitive arrangements for tanks which were, by the way, as good as need be, were barrels, sawed off so they stood about 28″ high. These were filled with water, and the dumping arrangement was something as seen in Fig. 6. A sieve is let down into the barrel and receives the work. When this is cool the sieve is lifted out and the pieces are laid on a sheet-iron over the hot boxes, or on some other convenient place, to dry. The barrel is tipped over, and emptied into the drain, and refilled to be ready for another batch. To avoid hurry and delay, as many barrels should be provided as are necessary to cool all the batch which is to come out at one time.

When work is of such a character that it is likely to be injured by falling too great a distance, the box is brought near to the surface of the water, when it is dumped, and the sieve is set at a slight depth in the water, and is balanced, so that, when the work strikes it, it will sink slowly to the bottom. This plan is adopted, also, when the articles which are hardened for color are so large that they would not cool well, if allowed to fall immediately to the bottom of the tank, with the ashes. By being obliged to fall slowly through the water, they are hardened before they reach the bottom.

Work that is slotted is apt to spring in such a manner as to close the slots, and it is therefore good policy to wire in plugs, to prevent this result. It is safer to close a slot which has sprung open than to wedge one open which has sprung shut.

As the outside coating of the work is changed to steel, and is subject to the same conditions as other steel, the hardening of articles which would be liable to spring, if cooled in water, may be preferably done in oil. Sufficient oil is used to cover the article immersed. Too much oil is not as efficacious as a small quantity in close contact with cold water. This will transfer the heat from the hot steel to the cold water quicker than it can be absorbed by a larger body of oil. To produce an ornamental black by case-hardening in oil, the articles must be allowed to come in contact with the air as little as possible before cooling.

Odontics, or the Theory and Practice of the Teeth of Gears.

BY GEO. B. GRANT.

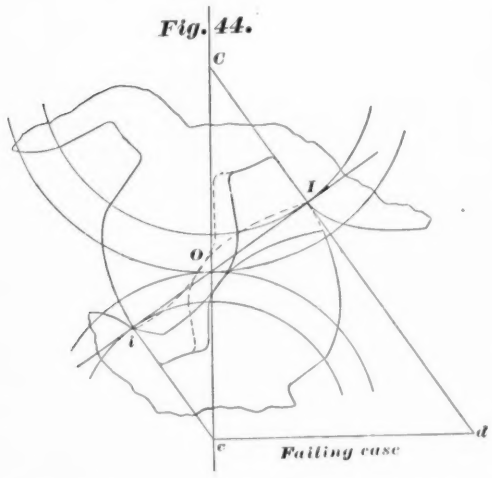
SIXTH PAPER.

65.—INVOLUTE GEARS FOR GIVEN OBLIQUITY AND ADDENDA.

When the obliquity and addenda, as well as the pitch diameter and number of teeth in a gear are given, as is generally the case, we can proceed to draft the complete gear as follows:

Draw the pitch line $p\ l$, Fig. 42, the addendum line $a\ l$, the root line $r\ l$, and the clearance line $c\ l$, as given. Draw the line of action $l\ a$ at the given obliquity $W\ O\ Z = K$.

Fig. 44.



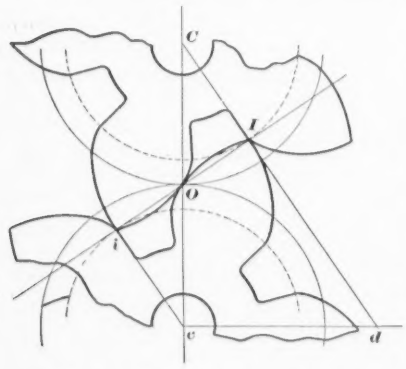
Draw the base line $b\ l$ tangent to the line of action. Find the interference point i by bisecting the chord $O\ c$.

Draw the involutes $i\ a\ m$ and $i''\ a''\ m''$, and $a\ a''$ will be the maximum arc of action.

If the given arc of action $a\ a'$ is not greater than the maximum arc, the pitch line is to be spaced and the tooth curves drawn in from the base line to the addendum line. These tooth curves, when small, are best drawn as circular arcs from centers on or near the base line, one center x for the flank from the base line to the pitch line, and another center y for the face from the pitch line to the addendum line. One involute $i\ a\ m$ should be carefully constructed by points, and then the required centers can be found by trial. One center and arc will often answer for the whole curve, and it is only when great accuracy is required that more than two centers will be necessary.

Continue the flanks of the teeth toward center by straight radial lines, and round these lines into the clearance line.

If the interference point for the gear that the gear being drawn is to work with is at I, within the addendum line, the limit line $l\ l$ must be drawn through it, and the points of



4.62 × 4.62 limit for equal teeth

Fig. 45.

the teeth outside of this limit line slightly rounded over, to avoid interference (55).

If a fillet f is desirable to strengthen the tooth, it can be drawn in by the method of (44).

66.—INVOLUTE GEARS FOR GIVEN NUMBERS OF TEETH.

When the numbers of teeth and the pitch lines are the only given details, the shape and action of the tooth depends upon the obliquity, and the action will fail if the angle is too small. The principal object is to determine the least possible angle that is permitted by the given pitch diameters and numbers of teeth.

Draw the pitch lines $P\ L$ and $p\ l$, Fig. 43, lay off the given pitch arc, as a straight line $c\ d$ or $C\ D$, at right angles to the line of centers, and draw the line $C\ d$ or $c\ D$. Then the required line of action will be $l\ a$ passing through O at right angles to $c\ D$ or $C\ d$. The complete teeth can then be drawn in as previously directed.

In this case, the obliquity $W\ O\ Z$ being the least possible, the limit lines and the addendum lines must coincide, but the addenda may be reduced by increasing the angle.

67.—INVOLUTE GEARS FOR GIVEN OBLIQUITY.

When the pitch diameters and the obliquity are the only given details, the lines $C\ I$ and $c\ i$, Fig. 43, drawn from the centers at right angles to the line of action, will determine the limit lines. The maximum arc of action $a\ a'$ may be found either by drawing the involutes $i\ a$ and $I\ a'$, or by continuing the line $C\ I$ to the line $c\ d$, and measuring the required distance $c\ d$. Any arc of action less than $a\ a'$ may be used.

The drawings should always be made to a scale of one tooth to the inch radius, so that the pitch arc will be 2π. If the scale is one tooth to the inch of diameter, the pitch arc will be π.

68.—INVOLUTE GEARS WITH LESS THAN FIVE EQUAL TEETH.

The method of Fig. 43 and (66) will be found to apply to any given numbers of teeth not less than five, and to fail, if either gear has but three or but four teeth. Any external gear of five or more teeth will work with any external gear of five or more teeth, and with an internal gear of any number of teeth unless stopped by internal interference (64).

For example, if a pair having four and five teeth, Fig. 44 is tried, the four-toothed pinion will fail, because its tooth will come to a point upon the line of action before it has passed over the required pitch arc. The difficulty cannot be remedied by increasing the obliquity, for an angle that would allow the four-toothed pinion to act, would also cause the five-tooth pinion to fail.

The practical limit is five teeth, but the mathematical limit is the pair having the fractional number 4.62 teeth, Fig. 45.

The four-toothed pinion will not work with any external gear, not even with a rack, but it will work with an internal gear that has about ten thousand teeth, and is practically a rack. It will work with any internal gear having less than ten thousand teeth, and Fig. 46 shows it working with an internal gear of six teeth. Internal interference will prevent its working with an internal gear of five teeth.

The three-toothed pinion has no practical action. It has a mathematical action with internal gears of 3.56 or less teeth, as shown by Fig. 47, but as its limit is less than four, it cannot work with any whole number. The figure shows the interference at a.

The extreme mathematical limit may be said to be the gear of 2.70 teeth, which has a theoretical action with an internal gear of the same size, coinciding with it.

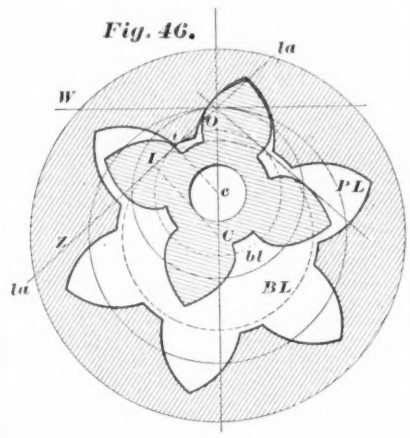
69.—INVOLUTE GEARS WITH LESS THAN FIVE UNEQUAL TEETH.

If we drop the condition that the pitch line must be equally divided into tooth and space arcs, we can make gears of three and of four teeth work with external gears by the method of (65). The failing case of Fig. 44 may be corrected by widening the failing tooth until it acts, and narrowing the other tooth to correspond, as shown in broken lines.

In this way a four-toothed pinion will work with any number of teeth not less than 5.57, at which limit both gears have pointed teeth, as in Fig. 48.

The three-toothed pinion will work with any gear having 10.17 or more teeth. Fig. 49 shows the 3 x 10.17 limiting pair, and Fig. 50 shows the three-toothed pinion working with an internal gear of five teeth. It will not work with an internal gear of four teeth, on account of internal interference, and therefore the combination shown by Fig. 50 may be said to be the least possible symmetrical involute pair.

Fig. 46.



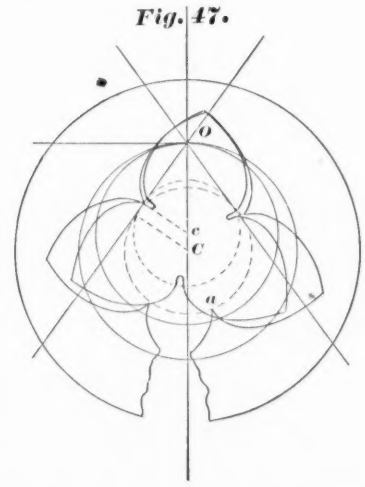
A gear of 2.70 teeth will work with a rack, but there seems to be no way to make a pinion of two teeth work under any circumstances.

70.—THE MATHEMATICAL LIMITS.

The above results for low numbered pinions can be obtained by graphical means, but that method is not accurate enough to determine the limits with great precision, and in any case is tedious and laborious.

The mathematical process is not particularly difficult, and consists in repeated trials with given formulæ.

Fig. 47.



To determine the obliquity at which a limiting pinion will be pointed on the line of action, for tooth equal to space, we use the formulæ:

$$tan.\ h = \frac{2\ \pi\ M}{n\ (M+n)+4\ \pi^2}$$

$$\frac{4\ M}{M+n} - \frac{h\ n}{90} = 1,$$

in which n is the given number of teeth in the pointed gear, Fig. 51, M is the number in the gear having the radius $O\ M$, and h is the angle $O\ c\ I$. Knowing n, we assume a value for M, and from that find a value for h by means of the first formula. This value of h, tried in the second formula, will give an error. A second assumption for M will give a second error, and if the two errors are not too great a comparison will nearly locate the true value of M.

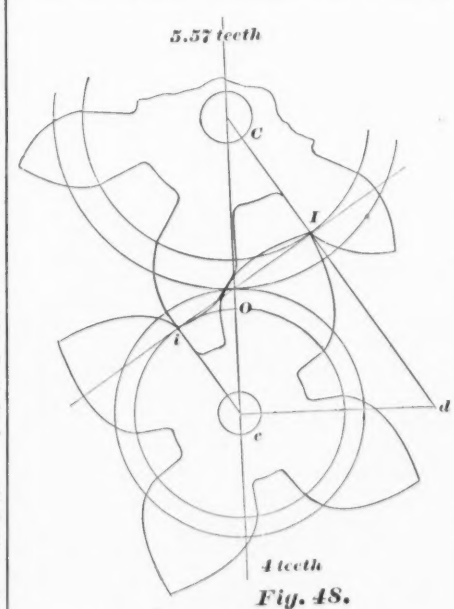


Fig. 48.

Knowing n and M, we find the obliquity from

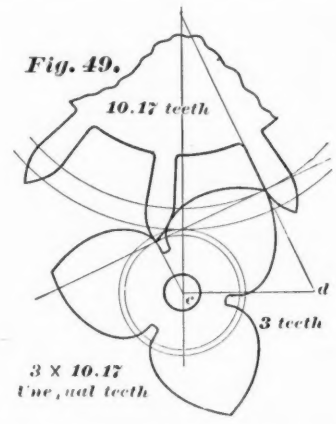
$$tan.\ K = \frac{2\ \pi}{M+n}.$$

In this way the following values were determined:

n	M	K
2.695	1.26	57° 49′
3.	1.51	54° 20′
4.	2.86	42° 29′
4.62	4.62	34° 11′
5.	6.75	28° 8′
5.58	∞	0

Having determined the obliquity for the pointed pinion, we can determine the least

Fig. 49.



number of teeth it will work with by means of the following formulæ:

$$Angle\ B = \frac{180}{\pi}\ \frac{n}{N}\ tan.\ K - \frac{90}{N} + K$$

$$tan.\ B = \frac{n}{N}\ tan.\ K + tan.\ K$$

in which N is the required least number.

In this way it was found that a gear of four teeth will not work with a rack, but will work with an internal gear having a number of teeth not easily calculated with existing logarithmic tables, but which is approximately ten thousand. Also that a pinion of three teeth will not work with an internal gear having more than 3.56 teeth.

For unequal teeth we can use the formulæ,

$$tan.\ h = \frac{2\ \pi\ N}{n\ (N+n)+4\ \pi^2} \quad tan.\ H = \frac{2\ \pi\ n}{N\ (N+n)+4\ \pi^2}$$

in which N and n are the numbers of teeth in the pair of pointed gears. By these formulæ the following results were determined,

n	N	K
2.695	∞	0
3.	10.17	25° 27′
4.	5.57	33° 17
4.62	4.62	34° 11

71.—MINIMUM NUMBERS FOR UNSYMMETRICAL TEETH.

If we drop the condition that the fronts and backs of the teeth shall be alike we have an unimportant case that is similar to that already studied, but much more intricate.

If we carry this case to its extreme, and adopt single acting teeth, we have no minimum numbers at all, for any two numbers of teeth will then work together. Fig. 52 shows one tooth working with three teeth, and any other combination can be obtained. The minimum obliquity for a given pair is obtained, as in (66), by laying off the known pitch arc, $C\ D$, at right angles to $C\ c$, and drawing the line of action at right angles to the line $D\ c$. The obliquity is also given by the formula.

$$tan.\ K = \frac{2\ \pi}{N+n},$$

in which n and N are the numbers of teeth. When the obliquity is as great as is often the case for very low numbers of teeth the action may be impracticable on account of the great friction of approach (48). The gears of Fig. 52 will not drive each other on the approach, unless the tooth surfaces are very smooth, and the power transmitted is almost nothing.

72.—MINIMUM NUMBERS FOR GIVEN ARC OF RECESS.

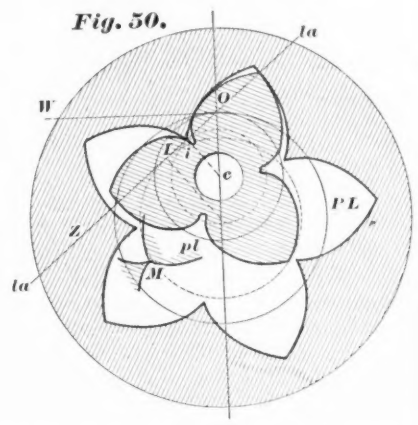
It has generally been assumed, although no good reason for the assumption has ever

been given, that the minimum numbers of teeth occur when the tooth of one of the gears, Fig. 53, is pointed at the interference point *I*, and at the same time has passed over an arc of recess *O a* that is a given part of the whole pitch arc *a' a*.

The solution is simple enough, graphically by repeated trials, or by a formula that can be applied directly without the usual process by trial and error.

But, as involute teeth have a uniform ob-

Fig. 50.



liquity, there is no necessity for assuming a definite arc of recess, and the condition on which the problem is based is unwarranted. No real limit is reached, and the matter is not worth examination at any length. The problem is investigated, for both bevel and spur gears, in either external or internal contact, in the Journal of the Franklin Institute for Feb., 1888, and it has received more attention than its slight importance entitles it to.

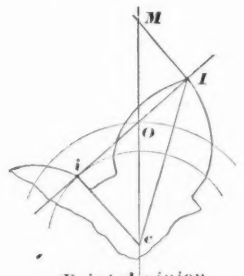


Fig. 51.

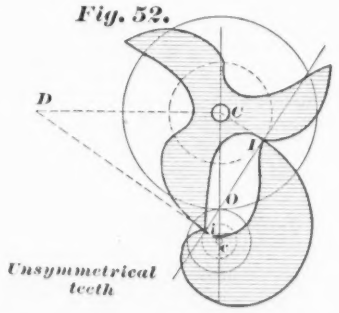
73.—EFFICIENCY OF INVOLUTE TEETH.

But little can be said in addition to the matter in (49), for both forms of teeth in common use are substantially equal with respect to the transmission of power.

From the formula of (49), which is the formula for the involute tooth, it is seen that the loss from friction is entirely independent of the obliquity, and, therefore, all systems of involute teeth are independent of the obliquity in this respect. This is contrary to the accepted idea that a great efficiency requires a small obliquity.

It has been stated on high authority that the involute tooth is inferior to the cycloidal tooth in efficiency, but the statement is not true. The difference in efficiency is minute, a small fraction of one per centum, but what

Fig. 52.



little difference there is is always in favor of the involute tooth.

74.—OBLIQUITY AND PRESSURE.

The involute tooth action is in the direction of the line of action, and the obliquity is a constant angle. It is variable only when the shaft center distance is varied.

As the pressure is always equal to the product of the tangential force at the pitch line multiplied by the secant of the obliquity (26), it is constant for the involute tooth.

Involute teeth, therefore, have a steady action that is not possessed by other forms; particularly by forms which, like the cycloidal, have a pressure and an obliquity that varies between great extremes.

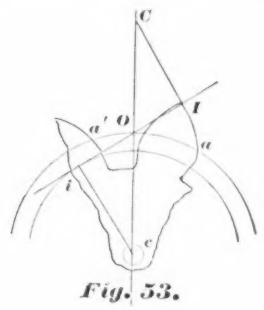


Fig. 53.

75.—THE ROLLER OF THE INVOLUTE.

The involute odontoid, like all possible odontoids, can be formed by a tracing point in a curve that is rolled on the pitch line, and this roller is the logarithmic spiral with the tracing point at its pole (32).

This feature is, however, more curious than useful, and it is not of the slightest importance in the study of the curve. Neither is the operation of rolling the involute mechanically possible, for the logarithmic roller has an infinite number of convolutions about its pole, and the tracing point would never reach the pitch line.

The involute is often considered to be a rolled curve, because it can be formed by a tracing point in a straight line that rolls on its base line; but, although that is the fact, it is a special feature, and has nothing to do with the rolled curve theory. The rolled curve theory prescribes that the odontoid shall be formed by a roller that rolls on the pitch line only.

Early Railroading in England.

Mr. Joseph Tomlinson, President of the Institution of Mechanical Engineers, in his address brought out some very interesting points in relation to early locomotive practice in England. After going into a description of the early types of engines, he continued:

"After this description of the early engines on the parent railway, it will perhaps interest most of you if I describe now some of the peculiarities of how the work was done by the men who were the pioneer workers of railway engines. In the first place, I will call your attention again to the fact that all the engines up to and including the 'Swift,' which was built in 1836 or thereabouts, had only two eccentrics, which, of course, necessitated hand-working to start in either direction. This of itself required a practiced hand to do, and would bother nearly every engineman of to-day, inasmuch as, since the abolition of the old Bury engine of the London & Northwestern Railway, that plan has become obsolete. There was no brake of any kind on engine or tenders, as I have said. The only way of controlling the trains down the banks was to put the engine out of gear, or for the fireman to drop off the engine, and let down as many wagon brakes as he thought necessary; and when they had to be taken off he had to repeat the operation of getting off and lifting them, he himself then getting on the last wagon of which the brake had been down, and walking along the top of the coals back to his engine. In my early days the engines were worked by contract by the driver, who found coal, oil, and every requisite, and was paid by ton of coal moved. The driver had two men in his pay, one a driver-fireman and the other a fireman. The steam was got up on Sunday night by the fireman, and the driver and he ran the first train on Monday morning (as early as coal was there to take) from Shildon to Middlesbrough, the then port of shipment. On the return to Shildon in about eight or nine hours, the fireman went home, and the driver with his driver-fireman ran the second trip; and on the completion of the second trip the driver went home, and the driver-fireman took charge as driver, and the fireman who had been resting resumed duty as fireman, and this system was followed day after day. No trains were run on Sunday.

"The other duties of these men were somewhat as follows. On the return after a trip the engine was taken to the coal depot, and coaled with a shovel by the men themselves ready for the next trip. If traffic was plentiful, the stay was short, and after a meal the engine was off again. There was no time-table. After going about a mile from Shildon, all the wagons had to be oiled, as there were no grease boxes; the engine was slowed down on the level to about three or four miles an hour, and the two men got down, one on each side, with his oil can and a hazel stick about three feet long, at the end of which a piece of oakum was tied; and with this the underside of each journal running in a cast-iron plummer block was carefully oiled. After all were done, they got on the top of the last loaded wagon, and walked back to the engine, and away they went. This was repeated after about twelve miles, when going in both directions. There was no guard and no brake van, and so all depended on themselves. As there was no van, it was necessary in the daytime to put a board up on the last wagon, so as to be sure they had not lost any of the train. At night a large pan of fire was affixed to the front of the tender, and to the last wagon, for the same purpose; and it was the duty of the fireman to keep both alight. There were no signals and no pointsmen, each man taking care of himself and his train, and keeping out of the way of the few passenger trains run.

"No passenger trains were run on Sundays, except between Darlington and Stockton once each way, which were worked by a horse. The carriage was on four wheels without springs, and was made to carry six inside and fourteen outside, including the coachman. It was like an old ordinary road stage coach with two front ends. The ordinary passenger trains on week-days had one first-class with three bodies, which could carry eighteen passengers; and one second-class, also with three bodies, which could carry twenty-four passengers; these two were attached at Darlington to the train which came from Shildon, and were put off at the junction at Stockton. The engine coming from Shildon brought a composite carriage with one first-class and two second-class bodies, or twenty-two seats, which was run on to Middlesbrough. The speed, including stoppages, averaged, say, 16 miles per hour for the whole journey of twenty-four miles.

"One engine not already described, which was also put on the old line, was the first goods engine with a crank-shaft, a fire-box proper, and a tubular boiler. It was built by Kitching, of Darlington, about 1838, and was called the 'Queen.' It had four wheels only, with cylinders below the level of the axles and inclined upwards, 13 inches in diameter and 18-inch stroke, and outside frames. All the wheels were coupled, and were of wrought-iron. The engine was very similar to engines made about 1839 and 1840, and put on many other railways; it was used for years, but with a pair of small wheels added behind. The Clarence Railway, which is now, like the Stockton and Darlington, a part of the present Northeastern, had mineral engines at starting very similar to those I have described. This line ran from Coxhoe to Port Clarence, with a branch to the old line, and was a rival to it; and hence any coal from Shildon to Simpasture, the junction, had to be worked by horses, as it had no running powers, and the Stockton and Darlington would not supply engines. Four wagons were drawn by one horse, and there was attached to the end what was called a dandy cart, into which the horse was trained to put himself when the loaded wagons would run by gravity. The first outside cylinder engine ever made with horizontal cylinders was put on this Clarence line, and was built by Hackworth & Downing on Shildon bank top. This Hackworth was a brother of Timothy, and afterwards started with Mr. Fossick the works at Stockton now known as Blair's. The engine had the usual return-flue type of boiler, with six wheels, coupled, and cylinders 13 or 14 inches in diameter and of 20 or 22-inch stroke. Up to this time all the mineral engines were innocent of framing, as it is now understood; all the parts for doing the work of drawing and carrying were attached to the boiler, and hence all were as light as could be made."

No Prizes.

Several times we have referred to the growing sentiment that the custom of giving prizes at exhibitions should be modified or abolished. There are certain evils connected with the practice which seem to be inseparable from it, and it has come to be that such prizes have a significance that is very imperfectly understood by the public.

George Berger, the director-general of the Paris exhibition, has an article in a recent number of the *Century*, entitled, "Suggestions for the Next World's Fair," in which he has the following to say regarding the subject of prizes:

"The question of recompenses calls for a considerable simplification of the practice in former exhibitions. It is my deliberate opinion that there should be no more international juries to judge the products on exhibition, and to award prizes. About all exhibitors of standing have already received premiums at one or other of the many universal exhibitions which have followed one another during the past forty years. The fear of not securing awards equal or superior to past successes, or of failing to be ranked as beyond competition owing to service as members of the jury, would have the effect of keeping away many producers, without whose presence the United States exhibition would fall short of the brilliancy and the interest which ought, by good right, to characterize it. It is my judgment that the juries of admission to the exhibition, in the United States and in all the other countries taking part, should be so organized as to assure their action at once with great strictness and with perfect impartiality. The principle must then be established that the admission itself to exhibit is, in the very beginning, a recompense, or, at least, an acknowledgment of merit, to the exhibitor, who will afterward receive further recompense in the appreciation of his products by the public, as well as in the business which will accrue, and the orders that will come to him. I may add that the terms of the general report of the exhibition, which might be drawn up by an international committee of men representing all specialties and taking the place of former juries, will place in their proper light any industrial or artistic excellences to which the admiration of the public, founded, as it is, often on mere appearance, may not have rendered full justice. It is not practicable that future exhibitions should offer to manufacturers, artists, agriculturists, anything more than an opportunity to bring forward their works for comparison with those of their fellows in foreign lands—a comparison platonic, indeed, in theory, but in practice full of instruction, of warning, and of revelation. I cannot urge the American commissioners too strongly to weigh carefully my opinion in this, shaped as it is by experience. I advise, however, that a diploma of admission and a commemorative medal be awarded to every exhibitor."

A Munich firm has made a carriage which is propelled by gas generated from benzine or analogous material. The motor, which is not visible from the outside, is placed in the rear of a three-wheeled carriage over the main axle, and the benzine used in its propulsion is carried in a closed copper receptacle secured under the seat, from which it passes, drop by drop, to the generator. The speed of the motor is absolutely under control, and can be regulated by pressing a lever. A speed of about ten miles an hour can be attained.

Engineering, in a recent issue, describes a boiler of the locomotive type, made by Hicks, Hargreaves & Co., of Bolton, which has a fire-box 8 feet by 8 feet 6 inches, the diameter of the barrel being 7 feet 6 inches. There are 409 tubes, each 2¼ inches diameter, 2,400 feet heating surface, and the working pressure is 160 pounds.

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Productive Efficiency.

The term production has not exactly the same meaning to all who are concerned in it. The machinist regards the production of a machine as complete when the various materials composing it have been formed, finished and properly assembled, so that the machine is ready for shipment. This, in the case of most machinery, is, of course, the major portion of production, but it seldom completes production, which, according to the economists, is not complete until the product is in the hands of the final purchaser and ready for use, the labor necessary to place a product in the hands of the consumer being as important as any other part of its production.

Viewed in this light, ships, railroads and express companies, which carry, as well as warehouses and stores in which goods are kept ready for the demand of consumers, become producers of those goods as well as the manufacturers who shape the materials composing them.

The more this view of the matter is considered, the more clearly it will be seen to be correct, not only for economists, but for everybody else as well. Whatever is necessary or expedient for placing goods in the hands of the consumer, after their construction or manufacture is complete, must, we think, be considered as part of their production.

The particular application we wish to make of this now is that it would pay as well to study and adopt the most efficient methods for this secondary production as for the prime or manufacturing stage of production.

As an illustration of what we mean we may mention the machinery warehouses and store-rooms in this city, though they are no worse, if, indeed, quite as bad upon the whole as those of other cities where machinery is stored for sale. Much of the machinery which is brought to New York for distribution is built in shops where the very highest efficiency seems to have been attained. The methods of handling this machinery in all the stores, so far as we know them, is in painful contrast, and, if we suppose a lathe planer, milling machine or steam pump to be endowed with perceptive faculties and feelings in such matters, they must be grossly outraged at the treatment they receive here. Imagine a lathe built in one of our modern shops equipped with traveling and swinging cranes as well as every other modern facility for handling work, to arrive in New York (though any other city would do equally well), where it is loaded onto a dray, which, after a time, arrives at the door of the "machinery depot," where it is to assist in captivating the eye of the man who is looking up the matter of new shop equipment. This is almost sure to be on one of the busiest streets of the city, crowded with pedestrians making their way to and from the great ferries.

The first thing done is to place a couple of heavy planks from the dray across the sidewalk to the door of the store at such a height as to force everybody to go into the street to get round, or, climbing over, seriously interfere with the work of the crowd of men and boys who, with wooden levers and crowbars, are trying to raise the lathe up to get rollers under it, those on one side usually prying up too strong for those on the other, at the imminent risk of a catastrophe, and with the certainty of provoking energetic, if not profane vociferation. After much of this work the machine is finally deposited upon the floor, and, if sold the next day, similar operations are gone through with in getting it back onto the dray. And this is the way that vast quantities of machinery are handled.

A trolley running upon an I beam, arranged to be run out when wanted, and supported upon standards placed each side of the dray, or by tie-rods from the building above, could easily be arranged, and would save about ninety per cent. of the present bother and expense of such work.

The shop having an equal amount of similar work to do, that should fail to adopt some such plan, would be considered antiquated, and would be unable to get its machinery handled by some of the proprietors of these very stores. There is really considerable room for improvement in such matters, and such improvement, if made, would in many cases tend to lessen the contentions which sometimes arise between dealers and manufacturers regarding prices, discounts and margins.

We hope to see some machinery store-room adopt a really efficient and modern method of handling machinery, and believe it would pay.

Keely's Perfect Machine.

A long article describing and illustrating the apparatus of John W. Keely for producing power by means of "sympathetic vibrations," was published in the New York *World* recently, together with what purported to be a partial revelation of some of his mysteries furnished by himself for publication. It is perhaps needless to say that the revelation is more mysterious than the mysteries it is supposed to reveal.

Keely announces, however, that he has finished his work, discovered his force, accomplished his task. "Henceforward," he says, "there is nothing for me to do but wait until the mechanics can make me a perfect machine. When that is done, I will at once demonstrate my discovery to the world." This, of course, is a perfectly safe proposition for him to make, and we suppose will effectually squelch Mr. Wilfred Lewis, who, as an engineer, has been asking him some bothersome questions, which yet remain unanswered.

Mrs. Bloomfield Moore is mentioned as the financial supporter of Keely, and there is also an interview with her, in which she connects Keely's mystery with that other great mystery, Browning's poetry, and apparently tries to give the impression that Browning had an inspired knowledge of Keely's force, and referred to it in some of his mysterious passages, which nobody can understand, and which might just as well be connected with any other unknowable thing.

This interview of Mrs. Bloomfield Moore's, by the way, sounds strangely like a letter published in the *Philadelphia Enquirer*, April 16, signed "H. O. Ward," this letter being an incomprehensible, poetry-quoting attempt to answer some of the direct and concise questions of Mr. Lewis, referred to in our issue of April 24. His reply, a copy of which is in our possession, was declined by the paper mentioned, at which we must confess to some surprise, as it seems to us to be just such a communication as editors are usually glad to get hold of when they themselves are unbiased, and have their journalistic eyes wide open. Altogether we must conclude that the present eruption is somewhat interesting as a psychological study, and any of our readers who may feel an interest in it, and who at the same time think they can build a *perfect* machine, may be able to make a contract; but we would advise them, as a preliminary course of training, to study Browning for a year or so.

The Secretary of the Navy is troubled because of the lack of a naval reserve. In the event of war he thinks there would be no one to man our warships. There is truth in this, and no doubt good reason for instituting a naval contingent that shall be of service in an emergency. It is more than likely the services of these men would never be required, but the fact that they were ready would be reassuring, while at the same time it would make the probability of their services being called for more and more doubtful as their number and proficiency increased. By all means we should have a "naval reserve." Time was when this country had such a reserve in its seamen who manned our ships that carried the American flag to every port in the world; but this is something of the past. The modern iron steamship has put this behind. Such a reserve as the Secretary can institute will doubtless be better than none at all.

The management of the Brooklyn Bridge has concluded to prohibit advertising in the bridge cars. Now, if the elevated roads in New York should do the same, what a wonderful educator would be lost. How would one know, to be sure, that his liver or some other vital part was out of order, and that to put it into a living condition he must take "Shonson's pills," unless he could read it in the cars, as he took his daily rides. Seriously, what a nuisance these car advertisements are. No one wants to have impending dissolution staring him in the face, as he goes to and returns from a hard day's work. But the advertisers pay well, and that is the main thing.

Literary Notes.

Kobbé's Jersey Central is the name of an attractively illustrated publication just issued, of size suitable for the pocket, cloth-bound, and containing 133 pages, and sold for only 25 cents. It aims to be "an accurate descriptive guide-book to the parts of Central and Northern New Jersey that are reached by the main stem of the Central Railroad of New Jersey and its branches."

The book is written in a lively vein, and contains much information regarding the physical characteristics of the country, as well as much interesting historical matter relating to the towns and cities included in its scope, together with a variety of information relating to industrial establishments, hotels, real estate values, house rents, car service, public and private buildings, institutions, etc. A number of maps are also inserted, showing driving roads, which alone will, to many persons, be worth the very small cost of the book. The publisher is Gustav Kobbé, 251 Broadway, New York.

The same publisher issues Kobbé's Road Maps, bound separately in pocket pamphlet form, and applying to various localities in the vicinity of New York City. These maps will be of value to persons desiring to make walking, riding or driving trips in the several localities. The three maps illustrating Central and Northern New Jersey, the Jersey coast, and Westchester County, N. Y. (the latter including part of Fairfield Co., Conn.), are sold at 25 cents each. The two maps referring to Long Island and Staten Island are sold at 10 cents each. Any of the series can be ordered through any newsdealer.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(211) P. R., Ottawa, Canada, asks: Does babbitt metal, if melted with cast-iron, make the casting or part of the castings hard? *A.*—We are of the opinion that babbitt metal will not mix with the cast-iron—it will burn up. If it has any effect at all, it will make the castings more brittle.

(212) J. S., Houtzdale, Pa., writes: I am trying to build a small locomotive—cylinders 1 inch diameter and 1½ inch stroke. Please give me the dimensions of steam and exhaust ports, and width of bridges. *A.*—Steam ports $\frac{3}{16}$ by $\frac{1}{2}$ inch; exhaust ports, $\frac{3}{8}$ by $\frac{1}{2}$ inch; width of bridges, about $\frac{3}{16}$ inch.

(213) C. O., Manlius, N. Y., asks: Can you inform me as to the method of making ice by the aid of compressed air on a small scale? *A.*—Machines for making ice on a small scale have not yet been perfected so as to be of any practical value. In our issue of May 29 we illustrated a large ice-making machine, and other illustration and descriptive matter will follow.

(214) F. B., Newark, N. J., writes: While talking with a gentleman the other day on the subject of compound engines, he claimed that the forward pressure on L. P. piston is only equal to the back pressure against the small piston. As I do not quite understand how that can be, I thought it would be best

to refer the question to you. *A.*—In compound engines the steam first performs work in the small or high-pressure cylinder, and is discharged into the L. P. cylinder, or into a receiver, from whence it is admitted into the L. P. cylinder. Hence the pressure per square inch on L. P. piston can never exceed the pressure per square inch of the discharged steam from the small cylinder: it is generally less, on account of the drop of pressure in the receiver, or in the pipes which lead the steam from one cylinder to the other. But it must be remembered that the L. P. piston is much larger in diameter than the H. P. piston, consequently the total forward pressure on L. P. piston is much greater than the back pressure on the small piston.

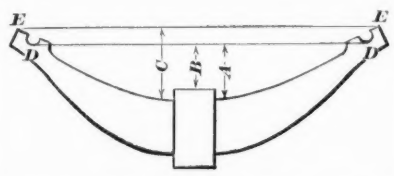
(215) W. A. M., Emporia, Kan., asks: How many pounds pressure (cold water) should a boiler stand to be considered safe under working pressure of 70 pounds? *A.*—For boilers which have been used for some time we should not allow the test pressure to exceed one and a half times the working pressure of the boiler; for new boilers the test pressure is sometimes allowed to go as high as twice the working pressure. We believe that any boiler which can stand a test pressure of one and a half times the working pressure, and sustain it during the time required for a thorough inspection, will be safe. Hence, if your boiler can stand a hydraulic pressure of 105 pounds, it should be considered safe with a working pressure of 70 pounds. We prefer to use warm water instead of cold. It may also be remarked that, in case of an old boiler whose condition may warrant some suspicion as to its strength, it should not be subjected to a hydraulic test until its form and strength of plates, determined by the thickness whenever that is possible, have been ascertained by inspection, so as to guard against over-straining. The test pressure should in this case not exceed one-quarter of the strength determined, and the working pressure should not exceed two-thirds of the test pressure.

(216) F. P., South Oil City, Pa., writes: In conversation with a blacksmith a few days ago he told me that bessemer steel is non-weldable, that a true weld cannot be made by the ordinary methods, or by the use of any of the generally known welding compounds used by blacksmiths; that the welds—so-called—really only affect the edges, and, while it may hold together and do for some purposes, yet the inside will not be welded. Can you tell me if this is so? *A.*—We have referred this question to B. F. Spalding, who answers as follows: "Steel which is made by the pneumatic process from good bessemer pig, and which contains not more than one part carbon to 3,000 parts iron (.0033⅓ carbon), will take a sand heat at the blacksmith's forge, and weld like iron. It is ingot iron. If it only welds on the edges, the rules for welding have not been followed. The most important rule is, 'Stick your weld first in the center.' Higher grades of steel weld less completely. As a rule, the better it hardens the harder it welds. Puddled iron made into merchant bars often contains as much as .0035 carbon. This will weld, relatively, better than ingot iron having carbon to the same amount; that is, the strength of the weld in relation to the strength of the bar will be greater in the merchant iron."

(217) A. H., Brooklyn, N. Y., writes: Kindly inform me how and where I can learn marine engineering, and what wages I will get while learning. I am sixteen years of age, and am at present employed in a machine shop where printing presses are made. *A.*—If you mean to fit yourself for running marine engines we see no other way than for you to seek employment in an establishment where marine engines are being built, study in the evenings papers and books relating to marine engineering, and be guided by the rule prescribed by the Board of Supervising Inspectors of Steam Vessels, given in our answer to Question 208, in our issue of May 29. If you intend to become a designer of marine engines, the best way will be to enter some technical school where marine engineering is taught. If circumstances will not allow you to do so, then seek employment in a marine engine shop, and obtain a practical knowledge of building engines, as well as experience in designing, which you can obtain by entering the drawing-room; study faithfully in the evenings, and do not get discouraged by the many years of hard work before you, but persevere—rewards are sure to follow. As to wages that you will get will depend on your own ability and faithfulness; they will probably be about the same as you receive now.

(218) A. G. B., Cortland, N. Y., asks: What is the best thing to put in a boiler which has had grease or tallow pumped into it? *A.*—Put in a little soda; for a 25 to 30 horse-power boiler about a half pound per day is generally found to be sufficient. The introduction of soda when grease is in the water will cause foaming, and is liable to give trouble if allowed to take place to any great extent. To avoid this trouble blow off frequently at the surface blow. It is sometimes thought that soda acts injuriously on the boiler plates, but this is not the case if the soda is pure and does not contain any acids. The injury attributed to the soda is sometimes caused as follows: In boilers fed with water containing corrosive impurities, together with matter that forms a thick incrustation, the damage done by the impurities is in time to a great extent prevented, and sometimes altogether concealed by the scale formed. On employing soda, and particularly caustic soda, which removes the incrustation, the defects in plates, whose presence may not even be suspected, become exposed, and, being attacked anew by the acids in the water used for washing out the boiler, which are not neutralized by the soda, are caused to *bleed*. This gives them the appearance of having been recently formed, and their presence is at once set down to the action of the soda. This leads us to the consideration of another valuable property of common soda; namely, its power of neutralizing the free acids so often found in the purest waters used for boiler feeding, as well as those containing large quantities of impurities, and which are the direct cause of pitting and forms of corrosion. Soda will prevent, or at least greatly mitigate, any corrosive action (*Wilson*). Many engineers use at present kerosene in place of soda to prevent the formation of scale.

(219) H. T., ——, asks: Will you kindly explain what the "set" of springs means? I have had considerable argument about it; some say it is the distance between the band and point of load, and others say it is the deflection. I am speaking of half elliptical springs. *A.*—The set of a half elliptical spring is measured in different ways. Some measure the set as shown at *A*, that is, from



the top of the upper plate to a line touching the points of support *D D*. This is, we believe, the proper way to give the set of the spring, because the distance between the points of support *D D* is usually given as the length of the spring, and therefore the set should be given from the same points. Again, a measurement of this kind will give us the correct and easy way of comparing the set of different springs. Sometimes the set is measured as shown at *B*, that is, from the top of band to the line *D D;* this we believe to be an incorrect way of measuring the set, because the thickness of the bands may vary. Sometimes the set is measured from the top of plate to a line drawn across the ends *E E* of the spring; this should also be condemned, because the ends are often cut off inaccurately. To avoid all trouble in ordering the springs, the best way is to make a complete drawing of the spring, marking the set as shown at *A*, and also state whether this set is with or without the load. The length from *D* to *D*, number, thickness and width of plates, and dimensions of band, and the load to be carried, should also be given. By deflection of the spring is meant the difference in sets for different loads.

(220) X. Y. Z., Providence, R. I., writes: Kindly give me a simple rule for computing the angle of torsion of a shaft when the radius of the resisting force, radius and number of revolutions of the driving pulley, and length of shaft are given. *A.*—The best way to pursue will be to find the horse-power which the shaft transmits. Suppose the shaft is 20 feet long, 2½ inches in diameter, transmitting 10 horse-power, and making 80 revolutions per minute, it is required to find the angle of torsion. To compute this angle we may employ the following formula:

$$i = \frac{10.2 \times M \times x}{C \times d^4},$$

in which i is the angle in circular measure, through which the one end of the shaft has turned relatively to the other end, when the working strain has been produced; M is the twisting moment in inch-pounds; x, the length of shaft in inches; d, the diameter in inches; and C, the co-efficient of the transverse elasticity of iron, for which Rankine gives a value of 9,000,000 pounds per square inch. The twisting moment M is easily found as follows: The total number of foot-pounds transmitted in one minute is $33,000 \times 10 = 330,000$ foot-pounds, and in one revolution $\frac{330,000}{80} = 4,125$ foot-pounds of work are performed. Now the circumference of a circle is equal to 6.2832 times the radius, consequently the amount of work performed (4,125 foot-pounds) is equivalent to

$$\frac{4,125}{6.2832} = 656.5 \text{ pounds},$$

acting on a wheel of one foot radius, and $656.5 \times 12 = 7,878$ inch-pounds, which is the required twisting moment. Now substituting for the symbols their values, we have

$$i = \frac{10.2 \times 7,878 \times 240}{9,000,000 \times (2.5)^4} = 0.054,$$

which is the angle of torsion in circular measure. In circular measure we take the radius as the unit of measurement; for instance, the arc which subtends two right angles, or an angle of 180 degrees, is said to be 3.1416 radii long; hence, to find the number of degrees in the angle of torsion, we have the following proportion:

$$3.1416 : 0.054 :: 180 : i,$$

which is equal to

$$\frac{0.054 \times 180}{3.1416} = 3° 9'.$$

Of course this result is only an approximate one, because this angle will change with the quality of the iron.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Lexington Cut Iron Gears. See adv. on p. 20.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Mech'l Drawings; best; cheap. Box 457, Reading, Pa.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells & Co., 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Ice and Refrigerating Machines, 155 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Crank pin Machines. Pedrick & Ayer, Philadelphia, Pa.

Planer Chucks—Greenwood's Universal. Pedrick & Ayer, Philadelphia, Pa.,

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Standard Tool Co.'s Twist Drills. S. A. Smith, 23 S. Canal st., Chicago, Western Representative.

Well-drilling Machinery and Tools. Williams Brothers, Ithaca, N. Y.

Audubon Machine Works, New Haven, Conn. Special machinery, heavy and light.

Steel Name Stamps, etc. Address W. G. Sackmann, 1099 First ave., Cleveland, O.

Get particulars of our new Wall, Suspended and Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

For Pattern Letters, Steel Stamps, Burning Brands, Mach'y, Plates, &c., A. A. White & Co., Prov., R. I.

F. C. & A. E. Rowland, New Haven, Conn. Hydraulic, Mill and Special Machinery to order.

Send to H. W. Knight & Son, Seneca Falls, N. Y., for Catalogue of Pattern Letters and Figures.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal st., Chicago, Western Agent.

Patent Attorney. R. G. DuBois, 715 11th st., Washington, D. C., procures first-class patents on inventions. Valuable Hand-book on patents free.

Horton's Chucks. We offer the balance of our stock at 50 per cent. discount. McFadden Co., Philadelphia, Pa.

25″ Upright Drills a specialty. Finely made,
28″ great capacity, quickly operated, prices low.
32″ Send for list of firms using our Drills. J. E.
36″ Snyder, Worcester, Mass.

25″ } "Only Drill Press built on
32″ } 'Ko-rekt' principles,
37″ } even if they come from Jersey."
42′ } Gould & Eberhardt, New Ark, N. J.

Patents.—Patent soliciting of high class.
D. Walter Brown, 31 Nassau st., New York.
Send for "A Brief History of Patent Legislation in the United States."

C. H. Redman & Co., Newark, N. J., Manufacturers of Light Machinery, Automatic Selling Machines. Telephone and Telegraph Instruments, Sewing Machine Attachments, Models, etc. Contracts solicited.

For Sale—Bound volumes of the Patent Office Gazette for years 1883, 1884, 1885, 1886, 1887 and 1888. Price, $4 per year. Address J. C., care of AMERICAN MACHINIST.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices' contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

Montgomery & Co., 105 Fulton st., New York City, have just issued a small catalogue of 160 pages, containing description and prices of many useful tools. A copy will be sent free to any address upon application.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting
Rods for small connections.
Especially adapted for Valve
Rod for Steam Engines.
T. C. Dill Machine Co.,
Philadelphia, Pa.

Screw Propellers.
Manufactured by H. B. Roelker,
22 Cortlandt st., New York.
Superintendent of the late De Lamater Iron Works, of same patterns and designs as before, adapted to each vessel. Consulting Expert and Constructing Engineer. Estimates on machinery, damages, etc. Air ice machines.

Just concluded. "Modern Locomotive Construction." By J. G. A. Meyer. The above series of 106 articles, which have attracted so much attention everywhere, is now concluded in newspaper form. Copies of the American Machinist containing the entire set sent by mail to any address in the U. S., Canada or Mexico for $5.30, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

Just concluded. "Practical Drawing." By J. G. A. Meyer. Copies of the American Machinist containing the above series of 93 articles sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

MANUFACTURES

Johnson City, Tenn., will have machine works.

A $400,000 cotton mill will be built at Norfolk, Va.

At Piedmont, Ala., machine shops will be established.

An Ohio company will locate machine plant at Danville, Va.

The Linden Mfg. Company will build a $2,500 factory at Davidson, N. C.

The Peabody Mills, of Newburyport, Mass., are to build a new boiler house.

The Beverly (Mass.) Building Association recently opened its third new brick factory.

The contract has been awarded for erecting the Huntingdon Boiler Works at Iron Gate, Va.

The Knowles Pump Company, of Warren, Mass., are to build a large addition to their foundry.

The Ivanhoe (Va.) Iron Company is organized. Capital stock, $250,000. W. C. Van Doren, president.

The Falulah Paper Company's new mill, at South Fitchburg, Mass., will be 55x200 feet, of brick.

The Cape Ann Drop Forge Works, of Gloucester Mass., have been incorporated, with a capital of $20,000.

The North Carolina Steel and Iron Company will build two seventy-five ton furnaces at Greensboro, N. C.

The Voltaic Electrical Manufacturing Company, with a capital of $1,000,000, has been organized at Memphis, Tenn.

A joint stock company, with a capital of $50,000, has been organized at Shreveport, La., to erect a canning factory.

A New Orleans (La.) syndicate has decided to build one fifty-ton charcoal iron furnace at New Birmingham, Tex.

Extensive machine shops are being erected at Elkins, W. Va., by the W. Virginia Central & Pittsburgh Railroad Company.

Contracts for the new buildings of the Farre Foundry and Machine Company at Waterbury, Conn., have been awarded.

The Planters' Oil Mills, of Monroe, La., has been incorporated, with a capital stock of $100,000. The company will build at once.

The Hampton (Va.) Manufacturing Co. has enlarged its factory, and will put additional machinery in its wood-working factory.

The foundry and machine shop lately erected by T. D. Wardlow and others at Warren, Ark., will be known as the Warren Iron Works.

Robinson & Thomas will erect an iron and wood-working shop at Alexander City, Ala., and contemplate putting in an electric light plant.

There is a movement towards building a machine shop at Dexter, Maine, to be occupied by A. B. Pitkin, Dexter, Maine, in building machine tools.

D. H. & A. B. Tower, of Holyoke, are to make plans for a new fifty-ton sulphite fiber mill at Madison, Me., in which ex-secretary Whitney is interested.

The machine shops of the Houston & Texas Central Railroad Company, now located at Corsicana, Texas, will, it is reported, be moved to Ennis

The Batesville (Ark.) Flouring Mill and Manufacturing Co. has been organized, to erect a seventy-five barrel roller flour mill. The capital stock is $25,000.

The Lexington Foundry and Hardware Company—capital, $50,000—has been organized to establish a stove foundry and machine shops at Lexington, Ky.

The Gadsden (Ala.) Bar and Steel Mill Company has been incorporated, to erect a bar rolling mill and two sheet iron mills. The capital stock is $150,000.

Ground has been broken for a new box factory at Ashland, Wis., in which about $50,000 will be invested. It is to be operated within ninety days. About 100 men will be employed.

V. W. Crowson & Co., cotton waste manufacturers, of Westfield, Mass., who were burned out recently, are to have their factory rebuilt, and will resume business on a larger scale.

The Lexington (Ky.) Foundry and Machine Co. has been organized by W. J. Houlihan, J. M. Kelley, and others, to establish a stove foundry and machine shop. Capital stock, $50,000.

Hill, Clarke & Co., Boston, Mass., issue a list of tools which they will sell, the tools being now in operation in the locomotive department of the Mason Machine Works, Taunton, Mass.

One hundred and sixty-eight foundries and machine shops were established in the South last year. Tennessee, twenty-five; Virginia and Kentucky, each twenty-two; Georgia, twenty-one.

The firm of Beecher & Peck, New Haven, Conn., has been changed to the Miner & Peck Mfg. Co. The new firm will be the sole manufacturers of the Peck patent drop press, and will do drop forging.

An addition has just been completed by the Mahoning Boiler Works at Youngstown, Pa., measuring 60x140 feet. It is fitted up with a ten-ton crane and a new riveting machine with a ten-foot gap.

The Breathitt City Bridge Company has been chartered by the State legislature. The legislature has also passed a bill providing for bridges across the Abbott and other rivers in Floyd County, Ky.

The Jacksonville Mining and Manufacturing Company, of Tredegar, Tenn., has made arrangements for the building of two charcoal iron furnaces, and negotiations are pending for a third furnace and a rolling-mill.

Work has begun on the new iron furnace at Basic City, Mo. The stock-house will be 75x200 feet; the cast-house, 50x100; the engine-house, 50x68; and, together with the boiler-room, sheds, etc., will occupy a space of ten acres.

Negotiations are about being closed with a Western company, whereby a large machine plant, representing varied industries, will be located at Buena Vista, Va. This plant will employ about 300 to 500 skilled mechanics.

A machine shop and repairing building is now being erected at the plate-glass works, Kokomo, Ind. It is 200x117 feet, and will be used as a general repair shop. To this will be added a still larger structure to be used as a foundry.

Belton, Texas, has raised a cash bonus of $75,000 to be used in persuading the Santa Fe Railway Company to move its machine shops from Temple to that place. The $75,000 will be donated, as well as ground on which to build the shops.

H. P. Cummings & Co., of Ware, Mass., have been awarded the contract to build an addition to Charles A. Stevens & Co.'s woolen mill. The building will be five stories high, 50x82, with a picker-house adjoining, three stories high, 35x47.

A company is being formed at Pittsburgh, Pa., for the manufacture of the Smyth oiler for car journal boxes, the invention of W. O. Smyth, of the Lake Shore road. W. T. Paul, of the Damascus Bronze Company, is one of those interested.

The Pittsburgh Boiler Scale Resolvent Company, Pittsburgh, Pa., has issued a catalogue of books on mechanical subjects that will be furnished free to each purchaser of a barrel of resolvent. The list of books comprises some very excellent ones.

The Duvall Engine Company, Zanesville, Ohio, has made a proposition to remove their entire plant to Sherman, Tex. This factory has been running sixty years, employing 150 hands in the manufacture of portable and stationary engines and boilers.

William Gothard, of Menominee, Mich., expects to build a box factory at Ontonagon that will employ 125 hands or more, and turn out about 12,000 boxes daily. The product will be taken by the Diamond Match Company, which will supply the timber from its saw-mills.

E. & J. Fred Webster and other capitalists, of Bangor, Me., are arranging to form a stock company to build a paper mill at Orono, Me. The new mill will have a capacity of sixteen tons per day. D. H. & A. B. Tower, of Holyoke, Mass., will probably be the architects.

The Standard Chemical Manufacturing Co., capital stock $30,000, has been organized at Portland, Me., for the purpose of manufacturing and dealing in metal polish. The officers are: President, Wendell H. Cobbe, of New Bedford, Mass.; treasurer, Walter J. Ramsey, New Bedford.

The Farley Paper Company, of Wendell Depot, Mass., has received $13,000 insurance on its burned mill. The company will rebuild at Farleyville, where the Fitchburg Railroad Company will erect a passenger station. The new factory will be 30x140 two stories high, and will cost $35,000.

Messrs. J. C. Gray & Co. have closed contract for the Berlin Iron Bridge Co. for a puddle mill building, 310x75 feet, to be built at the new town of Richlands, Va., for the Clinch Valley Coal and Iron Co., and also for a parabolic iron bridge, span 180 feet, to join the two sections of the town of Richlands, which are separated by the Richlands creek.—*Manufacturers' Record.*

The paper mills at North Bridgeport, Conn., which were closed last summer, have been purchased by Frank R. Walker, a New York paper manufacturer, who will commence repairs on the property at once, and start work in about two weeks. Book and manila paper will be manufactured.

There is water-works agitation at Walla Walla, Wash.; Gainesville, Ga.; Berkley, Va.; Cape Girardeau, Mo.; Riverside, Cal.; Florence, S. C.; Tacoma, Wash.; Hiawatha, Kan.; Bridgeport, Ala.; Brinkley, Ark.; Herman, N. Y.; Hoosick Falls, N. Y.; Lynn, Mass.; Monrovia, Cal.; Calville, Wash.; Tenville, Ga.; Dallas, Texas; Reading, Mass.

Mr. Watson H. Bliss has removed his building business from Lewis street to Lumber street, Hartford, Conn., in the mill formerly connected with the White lumber yard. The new building has four floors, with 12,800 feet of floor space. New engine and machinery will be put in for carrying on all branches of the business. The large contract which Mr. Bliss has on hand has necessitated the larger quarters and a greatly increased force of hands.

The Middleton Machine Company, Middleton, Ohio, have had the lathe dog illustrated in our issue of August 29, 1889, in use for the purpose of testing its merits, in several large forge shops, and, as a result, are getting orders for large sizes. One order, from the Erie City Iron Works, Erie, Pa., calls for 10", 12", 14" and 16" dogs. The Middleton Company has just completed its new shop, and are well pleased with the extent of orders for their specialties.

A Chicago company is negotiating for the purchase of the Carleton County Iron Works, near Woodstock, N. B. These works were operated for some years by a company, of which the late James Harris, the car builder of St. John, was the principal member. They never paid, and were discontinued, but it is believed that the character of the ore is such that, under modern methods of treatment, working would be profitable.—*Canadian Manufacturer.*

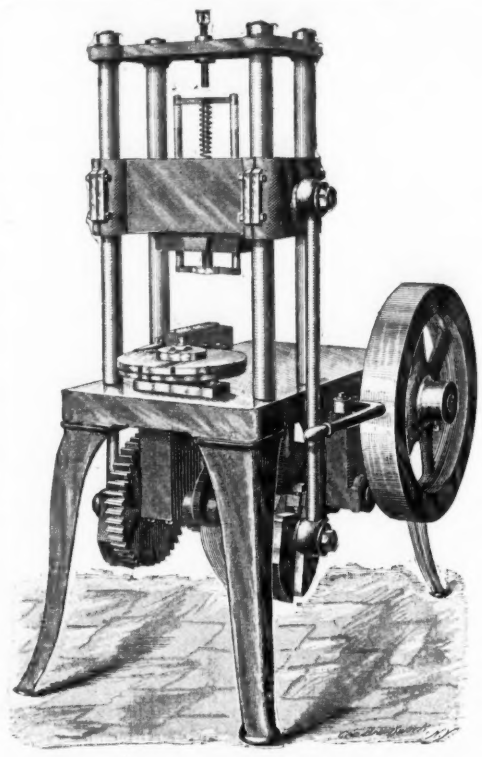
A very neat illustrated pamphlet has been issued by Pedrick & Ayer, of Philadelphia, which is devoted to a description and full directions for operating the locomotive link motion model manufactured by them, and which was described in our issue of December 5, 1889. The directions for using it contain much that enginemen will find interesting and instructive, whether they have the model or not, and it will be sent to those interested, on application.

Ireland & Hughes, manufacturers of oil well tools (Pittsburgh, Pa.), are making some further improvements at their works. In addition to the forty-foot extension to their machine shop, alluded to some time since, they are about to provide a place for two steam hammers made by Saml. Trethewey & Co., of this city, the heaviest of which will be about 3,500 pounds, and will be used in connection with a "scrapping" furnace now in process of erection. A siding just put in adds largely to the facilities with which they handle their fuel and stock.—*American Manufacturer.*

All the departments of the works of the Pennsylvania Steel Company are in operation, but, with few exceptions, there is no pressing demand. There has been no improvement in the steel market this week, and no heavy orders placed. No. 1 Bessemer mill was shut down on Monday afternoon, caused by the breaking of the cylinder head of the engine. Connections with the old engine in No. 2 Bessemer have been completed, and will be used for blowing in No. 1 mill. No. 2 Bessemer mill made a light run, occasioned by the breaking of a crab in No. 1 blooming mill, where the product is used. The iron frame-work for No. 3 open-hearth plant is in position.—*Steelton Reporter* May 17.

The Hartford (Conn.) Board of Trade recognizes the needs of the city's young but growing manufacturing concerns, and proposes to lend them a helping hand. A plan is on foot to secure a lot in a desirable location, and erect a building suitable for manufacturing purposes, which can be added to when necessary, and to be supplied with power from an engine and boiler house to be built for that purpose. At a meeting of the board, last week, the project was received with favor, and the following well-known gentlemen were appointed a committee to investigate the subject further: George A. Fairfield, Francis A. Pratt, T. O. Enders, C. C. Kimball, J. M. Thomson, George H. Day, J. M. Allen.

Post Falls, Idaho, is a town that started a year ago with a saw-mill, a store, and two or three residences, and has shown rapid development. There are now in process of erection, among numerous other industries and improvements, two saw-mills, a shingle mill, and a large sash, door and blind factory. The latter is being built by the Post Falls Mill Company. It is estimated that about 100,000,000 feet of accessible white pine grows on the St. Joe and Coeur d'Alene Rivers, and 40,000,000 feet on the St. Mary River, which can be profitably logged at five dollars. There are probably 75,000,000 feet of cedar, and billions of feet of white and yellow fir, tamarack, cottonwood, poplar, etc. Including what is further back, there is about 1,000,000,000 feet of pine.—*Northwestern Lumberman.*



Adjustable Stroke Drawing Press.

A new style of drawing press is represented by the accompanying engraving, in which one of the chief departures from the common practice is in the fact of its having an adjustable stroke, so that the plunger can be made to travel a long or short distance, as may be required by the nature of the work. This has heretofore been accomplished, but only by the use of rack and pinion movement, which necessarily involves some complication and limitation of speed, obviated by the present arrangement. Another novel feature is in the fact that the driving and crank-shafts are underneath the table, no strains whatever having to be borne by any portion of the frame of the machine above the bed plate, except the slight ones due to the angularity of the connecting rods. There are two of these rods, one at each side of the machine, connected below to wrist-pins, which are adjustable to the angularity of the connecting rods. This construction does away with the heavy parts of the frame usually employed above the bed-plate, and admits of much better light on the work, which is an important advantage.

The two shafts beneath the table are geared together, the second one having at each end slotted crank disks, in which are adjustable wrist-pins, to which the connecting rods are attached, thus providing for variation of length of stroke. A positive clutch is located on the driving shaft for stopping and starting, same as on an ordinary drawing press; and this clutch is so arranged that the machine is stopped when the crosshead is up. This machine may be used with dial for feeding, as represented, or the shells or cups may be fed by hand. The machine is provided with a knockout motion underneath the table, operated by a cam on the crank-shaft, which may be used to force a taper shell out should it remain in the die. The punch holder is secured to the underside of the crosshead as in ordinary presses, but a stripper is provided for removing the shell from the punch when the crosshead moves to the extreme end of the stroke in its upward movement should the shell remain on the punch. The size of press represented will draw shells 6" long, and any length shorter to ½", and weighs 3,200 pounds. It has been patented by Mr. Frank B. Manville, superintendent for Blake & Johnson, of Waterbury, Conn., by whom the press is built.

The gross receipts of the 23 principal railways in the United Kingdom, for the week ending May 4, amounted, on 16,159¼ miles, to 1,355,543*l*, and for the corresponding period of 1889, on 16,031 miles, to 1,302,576*l*, an increase of 128¼ miles, or 0.8 per cent., and an increase of 52,967*l*., or 4 per cent.

Note on Kerosene in Steam Boilers.

BY R. C. CARPENTER, LANSING, MICH.

(Presented at the Cincinnati Meeting of the Mechanical Engineers.)

The paper on this subject by L. F. Lyne, published in Vol. IX., page 247, induced me to give the oil a trial in the boilers of the steam-heating plant of our State Agricultural College at Lansing, Mich.

The boilers experimented on are of the ordinary tubular type, each being 12 feet in height, four are 4 feet in diameter each, and the remaining two each 5 feet in diameter.

The use of the oil was commenced in April, 1889, with the boilers very badly incrusted with a hard scale. Previous to this time the only method used to remove the scale had been by employing a workman to go inside the boiler and knock off what could be reached with a hammer and scaling iron. The estimated cost of this method of cleaning was $18 to $25 per annum for each boiler, and the results were very unsatisfactory, as more than two-thirds of the heating surface was entirely inaccessible. The scale was fully three-eighths of an inch thick in many places.

The first application of the oil was made while the boilers were being but little used, in the warm season, by inserting a gallon of oil filling with water, heating to the boiling point, and allowing the water to stand in the boiler two or three weeks before removal. By this method fully one-half the scale was removed during the warm season, and before the boilers were needed for heavy firing. We found, however, that a more effectual way was to apply the oil in small quantities when the boiler was in actual use. There is no question regarding the action of kerosene oil in softening the particular scale deposited from the water which we use (an analysis of that water is appended), and it also seems to work in between the scale and the boiler plate in such a manner as to loosen large flakes of the scale, sometimes fully a foot in length. On opening the boiler they are found deposited on the bottom, and readily removed by rakes; the great mass of the scale, however, is removed as a fine mud, through the blow-off pipe.

In regard to the quantity to be used, we found that beyond a certain amount no benefit seemed to result; for boilers 4 feet in diameter and 12 feet long we obtained the best results by the use of 2 quarts, or one-half gallon, for each boiler per week, and for each boiler 5 feet in diameter, 3 quarts per week.

The oil was readily fed by adding a one-fourth inch branch to the suction pipe of the feed pump, and leading it to a vessel containing kerosene oil. By this method a quantity as large or small as desired could be introduced into the boiler at the same time with the usual feed, and in the form of an emulsion of water and oil.

At the present writing our boilers have less scale in them than at any previous time during the past four years, and the small amount running in them seems to be soft and gradually disappearing. A large portion of each boiler shows the clean black steel, apparently in as good condition as when new.

I do not believe that the oil will produce any injurious effect on the iron—in fact, I cannot see why it is not the best possible preservative for it.

Our boilers are some distance from the various buildings heated, and steam is transported through underground pipes; the extreme distance being about 800 feet in opposite directions. Despite the small quantity of kerosene used in the boilers, the odor was perceptible by opening an air valve to any steam radiator in any of the buildings.

When as much as a gallon per week per boiler was used, the odor was very strong, but with one-half that amount it was hardly perceptible, and only to be noticed when an air valve had been open a long time.

Since commencing to use the oil, a much greater deposit of rust scales than usual has been found in the various steam traps in the buildings, indicating, in my opinion, that the oil is also exerting a cleansing influence on the pipes of our whole system.

The expense of this oil is very light, as compared with any other preparation for cleansing boilers known to the writer. The expense to the college per boiler has not exceeded $2 per annum for the kerosene used.

The water used in our boilers is obtained from a flowing well having a depth of 260 feet. The following analysis, by Dr. R. C. Redgie, shows its composition:

$Ca\ CO_3$ (Carbonate Calcium), 206 parts in 1,000,000.

$Mg\ CO_3$ (Carbonate Magnesium), 78 parts in 1,000,000.

$F_3\ CO_3$ (Carbonate Iron), 22 parts in 1,000,000.

Traces of sulphates and chlorides of potash and soda.

Total solid parts, 325 to 1,000,000.

Dimensions on Drawings.

BY A MECHANIC.

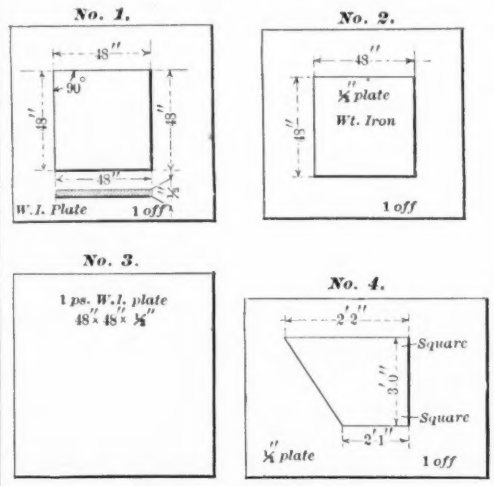
I have been bothered often, and I suppose others have been, in trying to get the designer's ideas of what degree of fineness is necessary. The question is always occurring, How near is it necessary to work to a certain dimension? In going to work in a new shop this question has bothered me so much that I have not been able to do a decent day's work till I got acquainted well enough to form an idea where all these parts went and what was required of them. Chordal says, "It is as foolish to do a job too good as not good enough." I believe this to be true. The mechanic who can work with judgment in this respect is the most valuable man to his employer. No man can work with judgment without he knows what is requ'red.

If a lot of telegraph poles are ordered to be 25′ in length, and they are found to vary 3″, I do not think they would be rejected. The same thing holds true with the dimensions in a machine shop. With the improvements in measuring instruments, it is possible to work very fine to a dimension, but to work everything as close as it is possible would not be practicable or good judgment. I have felt like fighting, and with good cause, I think, when a foreman gave me a job, with the orders to be particular, and when I got the job done, to have him come around and inspect my work with a two foot wooden rule. A shopmate was telling me of an incident, a short time ago. He was given a milling cutter to make, with the drawing. He worked very carefully to the figures given, and was careful to get the curves just right. He took lots of time and trouble, and was proud of his job; when he found that this accurate cutter was to make the notches in pipe tongs he was mad.

I suppose the idea is for the workmen to ask their foreman in a case of this kind. But this is a failure. I have often gone to a foreman to find out what was required; when he did not know, and was too lazy to find out, he would say, "Don't you know enough to work to the drawing?" At other times when he did know what was required he would the same as tell me he thought I was a fool for not knowing. It seems to me this is a curious kind of intelligence. Drawings are intended to be self-instructing; why not make them so, as far as is practicable?

I saw a drawing a short time ago like No. 1, in my sketch. It will be noticed that the figures given as they are would be likely to bother the machinist. It is a very ordinary piece of work, and there was no need of giving dimensions in that way. When the draftsman's attention was called to this he said, "It only shows it has been figured." I understand the distance to the moon has been figured, but I do not see the advantage of putting it upon a mechanical drawing.

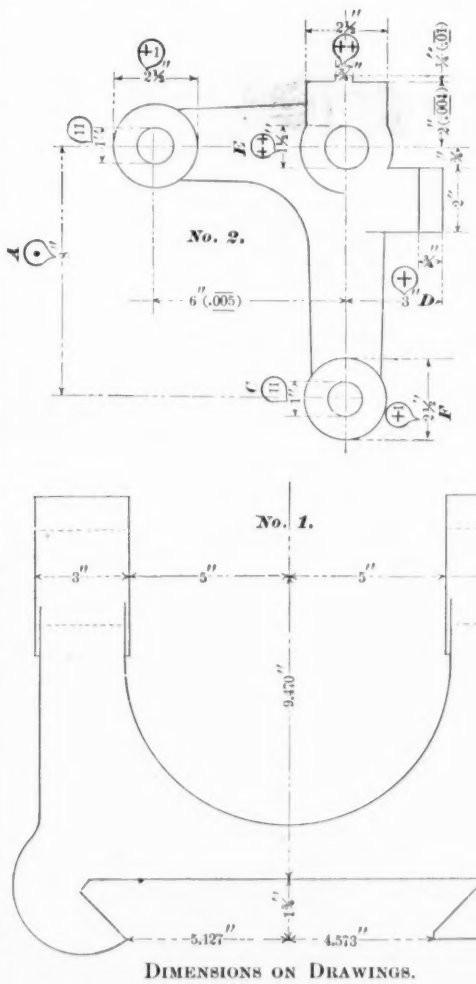
I have devised a way of conveying the designer's ideas to the mechanic. I cannot say that it is a new idea, but it is a new one to me. It is to use hieroglyphics. In my sketch (No. 2), I have tried to show the idea. The dimension given at *A* is not particular; the sign shows that the holes are to be in the center of hubs; the dimension is for the pattern maker. The dimension given at *B* (6.005″) is supposed to be quite particular, but we can allow .005 variation either way.



MECHANICAL DRAWING.

I use a short mark drawn over the variation when I wish it only above, and below when I wish it only under; in this instance, I use it above and below, to show that the variation can be either way. The dimension given at *C* is for a running fit, and the sign is sufficient to show this. The sign given at *D* represents that the pattern maker has allowed stock for planing, and that the machinist is only to plane a good surface. The sign shown at *E* represents a tight or driving fit. The sign shown at *F* represents a finished surface, but not to any particular size. When dimensions are not given in decimals, or with any prefix, I would consider that within 1-64″ would be near enough; when more than this can be allowed I would state what it could be, by a note, the same as in fine measurement.

This brings me to another idea. Would it not be a great advantage if all draftsmen and designers were good practical mechanics? I do not believe it is possible to make a good practical mechanic without at least five years' good solid experience. How many would "fill the bill"? When I see a drawing having marked upon it, "Heat this wheel to the temperature of boiling water, and shrink to place," I begin to lose confidence in that drawing. I have lately seen quite a number of bevel gears drawn with the length of hubs given in thousandths. In this way we can do a lot of very fine work, and produce a very poor job, when by leaving some stock on hubs for fitting we can do a lot of very ordinary work, and do a good job. I have seen the hubs of bevel gears worked accurate to drawings, and all other work done well, and when we came to fit them up it was a question of taking off a little here and putting on a little there. I believe in keeping up with the times, but I do not believe in going to extremes in anything.



DIMENSIONS ON DRAWINGS.

Mechanical Drawing.

BY W. H. BOOTH.

Going recently into the drawing office of a works where three fresh men were working against time upon some drawings for special machinery, I observed that each man had his own method and followed it, whilst the manager, who also did a little drawing, had his special method. In one thing only were the four draftsmen alike; namely, in the use of center lines of red ink, and dimension lines in blue; but to do him justice, this colored ink business was not part of the practice of one of the men, for he did it to oblige the boss, and not of choice. Sectioning was done by color laid on solid. Personally I detest to use red and blue ink; the waste of time getting it ready, and the constant wiping of pens, unless one has a special pen for each color, is a nuisance, and I began to recall the various systems under which I had myself worked in the past.

At the beginning I learned, as so many do learn, the system of fine lines, which accompanied the belief that a drawing should be able to be measured from. The folly of spending time in such careful exactness ought to have been apparent to the dolts who lay a rule on a drawing many years ago. Paper changes its dimensions with every change in weather, and moreover it changes differently in one direction from what it does in another. Map draftsmen draw a scale on their paper, and use it as they make their drawing, taking off every length with the dividers. This is rational anyhow, but should include a pair of scales, one drawn lengthwise, the other crosswise on the paper, to allow for each shrinkage.

In a mechanical drawing scales are rarely drawn on the paper, and no man of real sense expects a mechanical drawing to be accurately to scale, but he does expect it to be figured correctly. There are those who object to shade lines, because it is "difficult to measure to them." Teachers—mere book men—tell us that a shade line is to be all its thickness to one side of the line; *i*, *e*., to the shadow side of it, which is pedantically correct. Granted the use of shade lines, it seems folly to call for them so accurately placed as this. Granted, also, the use of shade lines, they need to run pretty well a sixteenth of an inch thick; when the drawing is to be blue-printed or otherwise, the thin lines will not be strong enough to print well, and what looks worse or is more productive of annoyance, wasted time and bad language than a badly blue-printed thin line. Now, no one can scale a drawing made with good stout lines and strong shade lines, and under certain circumstances I would allow shade lines, but generally—not because they cannot be scaled to, but because they are of no use—I would not use them, but make a uniformly thick lined drawing, and now I am old enough to do it, would strongly express my disapproval of that old chief draftsman who was wont to measure up lines on a drawing and growl if $\frac{1}{64}$th out in a length of 24 inches on a full size detail drawing, looking from one end to another of his rule a dozen times before he could satisfy himself.

This same man would have all dimension lines with right-angled arrow heads, and conventional figures 1, 2, 3, 4, very formal and stiff, and moreover carried his craze to the extent of insisting on sketches made in the roundhouse being also to scale. He was the worst case I ever met.

The best system I have yet found is that of making a drawing, 1st, wholly in black ink; 2d, with uniformly strong thick lines, center lines being an alternate long and short dash; 3d, with dimension lines and arrow heads put in with an ordinary pen—not a drawing pen—and by hand without the aid of any ruler. Thus put in, dimension lines are wholly different from all others on the drawing and cannot be mistaken, but they show up clearly and become what they ought to be, one of the most prominent parts of a drawing, always with large and distinct arrow heads.

Everything written on the drawing to be written in ordinary hand writing — not printed.

For sections, the brush and color alone to be relied on, small parts being wholly colored over, but larger areas sectioned in parallel dashes of color $\frac{3}{16}$″ or $\frac{1}{4}$″ wide, laid on as nearly truly as possible without a guide or ruler, simply by hand. Such a method produces plain, legible drawings with some character about them; a little practice enables any one to make them very neat, and by no means slovenly in appearance, as might be supposed.

No one who has once followed the method can follow any other of the slower old ways, which simply mean waste of time. A drawing in shop parlance ought to mean a sheet of paper from which the article to be made can be correctly got out. Thus, if I want a piece of iron plate 4 feet square and half an inch thick, I may send in a shop drawing in three forms. No. 1, with conventional plan and elevation. No. 2, in which I hand a sketch to no scale or accuracy, a rough quadrangle, and trust to the foreman's common sense to know I want a rectangular quadrangle, or I may make the "drawing" in the form of No. 3, the common sense form—simply writing on a minimum drawing sheet what is wanted, the foreman again understanding that if rectangles were not needed this would be stated; a drawing for a non-rectangular piece being, as in No. 4, with the departures from squareness figured on, a sketch which may best be exaggerated in its distortion from the rectangular as an aid against any misconception. With a so nearly rectangular plate, it would be possible for a short-sighted man to cut a piece of rectangular plate. With the distorted view, he sees at once there is a difference in the two sides, and proceeds to note carefully what this difference really is. To waste time in elaborate drawings, when simple ones will do as well, is a common error. As well send in drawings to the iron mills of inch bar iron. Pedantry is not accuracy, and the elaboration necessary for a workshop drawing to be read by technical men is altogether different from that appertaining to a pictorial representation of the article for exhibition to a county board or other assemblage of mere laymen.

I have seen supposed practical draftsmen who put in their arrow heads with the pen and 45° set square, and I have seen shops where the bulk of the drawings did not get beyond a piece of chalk and the back of the door, whilst odd things would be sketched out on the dirt with the toe of the boot; of the two styles the latter is preferable. There is some hope for the boot-toe man, but very little for the man who continues to show the heads of half-inch bolts, and every rivet head in a boiler, for many days after he has left the drawing class and commenced actual work.

In longitudinal sections of a railroad the vertical scale is usually exaggerated. The same principle may be advantageously carried out in machine drawing to obtain clearness of detail; many drawings when blue-printed, especially such as show junctions of several thin plates, are frequently liable to be misread, and, from the workshop or practical point of view, accuracy in result is far more to be sought after than accuracy in drawing.

The Mechanical Engineers.

Following the discussion of Willis E. Hall's paper (with which our last week's report closed for lack of space) was the presentation of a paper by A. F. Nagle on the Determination of Sensitiveness of Automatic Sprinklers. The purpose of the paper, as stated by the author, was to correct the erroneous opinion now held as to the *actual* temperatures at which automatic sprinklers open. It was premised that all modern automatic sprinklers use the same low-fusing solder (155° Fahr.) for holding their outlets closed, yet the time of opening differed considerably, being affected by the amount of solder to be melted, its proximity to masses of metal which could absorb heat, and the strain upon the solder. After describing the method usually employed for testing and determining the temperature at which such sprinklers will open, *i. e.*, by enclosing them in ovens of various sizes heated by a common gas stove, inserting a mercurial thermometer, and noting its reading at the instant of opening, he showed that this method was fallacious, the practical difficulty being with the thermometer, which, in such a test, would not show the actual temperature of the air surrounding the solder unless the element of time were taken into consideration. He pointed out the fact that, in air, the temperature of which was rapidly rising, as in these ovens, the temperature as indicated by the thermometer would always be somewhat lower than that of the air, and that the amount of its tardiness would depend chiefly upon the rate of rise in temperature. He claimed that allowance should be made for this tardiness in all such tests, and described a method adopted by him to determine what correction should be made for a given thermometer. He heated a thermometer over a gas stove to 300° Fahr., then, instantly removing it, its temperature was noted every ten seconds until it had fallen to the temperature of the room, which was 73°, the air being kept in circulation in order to avoid having the thermometer surrounded by air heated by contact with itself. By then heating the same thermometer first in a slowly heated oven, and then in a rapidly heated one, and carefully tabulating the results, he was able to obtain the proper correction to be applied to its readings to obtain the actual temperature of an oven at any moment. A similar course, he claimed, should be taken with any thermometer which it is proposed to use in such tests.

In discussing this paper, Prof. D. S. Jacobus said that a number of tests of such apparatus had been made by him under the direction of President Morton, for the New York Board of Fire Underwriters, and others, and his conclusion was that the sensitiveness of a sprinkler head is only one of many elements which must be considered in determining the value of a system, and that a small difference in sensitiveness would often be much more than counterbalanced by some other advantage which the less sensitive head may possess. He gave some description of the methods adopted, and claimed that, as the heater adopted was of such capacity that it could not carry the temperature much above the point at which the heads opened, the temperature at the instant of opening was rising very slowly, and that practically correct results were obtained. The most prevalent and at the same time the most dangerous defect usually found in sprinkler heads is the sticking of the valve to its seat after the releasing device has operated. Tests were described for this, which included, among other things, submitting them to the action of brine for three months before applying heat. Many other causes were mentioned which might contribute to the failure of an automatic sprinkler, the conclusion being that the exact temperature at which release took place is not the most important element, and that, in view of this fact, the temperatures were determined by the usual tests with sufficient accuracy for practical purposes.

Mr. Woodbury gave figures showing the comparative losses resulting from fires in buildings equipped with automatic sprinklers, and those not so equipped, showing them to be very efficient in keeping down fire losses. Commenting on these figures, Mr. Woodbury said:

"These results were reached by a very few automatic sprinklers, although the whole number of such devices is very great. I have in my possession 165 different forms of automatic sprinklers, most of which would not be reliably operative in case of fire, or they are so constructed as to be especially prone to leakage, or to disability by corrosion

"There are a great many forms of tests necessary to predicate the degree to which automatic sprinklers will withstand these numerous elements tending to impair their efficiency. The paper in question deals with only one matter, which must be considered; the other features being largely those relative to capability of withstanding water pressure, proper discharge of water, distribution of water, freedom from leakage either by jarring or by water pressure, freedom from sticking at the valve, freedom from disability by corrosion, positive operation when the solder is heated without being stopped by water impinging on the solder joint, opening temperature, and, lastly, the question of relative sensitiveness.

"An automatic sprinkler does not open at the fusion point of the solder (which is about 167° Fahrenheit), but at the critical point of the alloy, or the granular state."

Prof. R. H. Thurston, after referring to the value of Mr. Nagle's experiments in direct relation to the subject of which the paper treated, said:

"There is another direction in which we are, many of us at least, interested, and in which this bit of work affords valuable suggestions. One of the most important problems confronting the engineer interested in the applications of the heat engines is that of the determination of the laws and the data relating to the internal heat wastes of those most important of all products of the inventive genius of mankind. But we are there confronted by precisely such a difficulty as is here so well illustrated. We, as yet, have never been able to precisely determine the method of variation of temperature of the inner walls of the cylinder, and the method of storage of heat in them, so as to be able to predict, in any given case, just how much heat, and steam, and fuel, and money will probably be wasted by the phenomenon now familiarly known as 'cylinder condensation' in the steam engine, and in a slightly different form, no less influential in the production of losses in the other heat engines. Students of heat transmission all over the world, like Fourier and his followers, and engineers making their investigations of the actual economical working conditions of the machine, have been vainly seeking the solution of the problems thus brought before them; but all that we can to-day say is, that we can under certain conditions, and for certain cases, approximately estimate these wastes and the resultant efficiency of the engine. Could we secure exact measurements of the temperatures of the successive layers of the interior of the cylinder walls, it is very possible that we might determine with some accuracy the laws of such wastes. This has heretofore been attempted, but with no result. I have sought in all directions open to me a solution of this problem, but have not succeeded in obtaining what seemed desirable. I am hoping still to see some outcome of a useful, or at least suggestive nature, from researches now in progress, but have no reason to hope that they will fully meet the requirements of the theory of the real engine, as I have called it, to more than a very limited extent. This revelation of the absolute worthlessness of the mercurial thermometer for any such investigations is in itself likely to prove useful; though I presume that no one would to-day attempt to secure measures of varying temperatures by its use, under the conditions to which I now refer. Mr. Dixwell used a better system; but it looks as if only some modification of the electrical thermometer would give us determinations of any value.

"I hope to be able to give an account of

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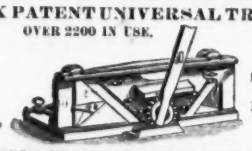

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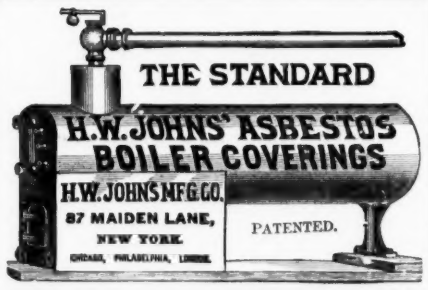

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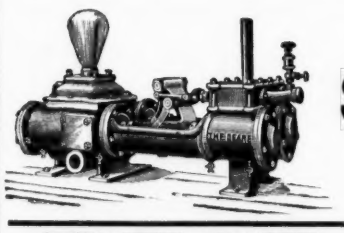

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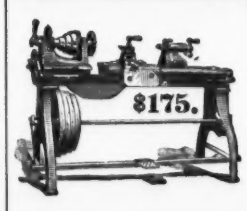

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MAKERS OF

METAL-WORKING MACHINE TOOLS

FOR

Locomotive, Bridge and Engine Builders, Railroad, Car and Machine Shops

AND

Iron and Steel Works Generally.

some such researches after a time; but I cannot, as yet, say that I have much expectation of being able to give such accurate data and determinations as are desired, and indeed required."

Mr. Charles Emery said:

The paper of the author shows very clearly the principles to be observed in the construction of automatic sprinklers, and the principal distinguishing features of apparatus and methods necessary to make proper tests of the same. The writer clearly points out how it is possible to test such devices, and state correctly the actual results obtained in detail, when, on account of the methods employed, the tests do not show the true comparative value of competing devices. This can be done in testing many other devices than automatic sprinklers. For instance, experts know, what house owners and many steam fitters do not, that the efficiency of a radiator depends upon the freedom with which air can circulate over the radiating surfaces; so engineers can be found who will make a careful test of a client's radiator with a given surface distributed over considerable length; for instance, with only two rows of small pipes, and test in comparison an opponent's wide, short radiator, arranged, say, to put the same surface, in pipes four or five rows deep. The long, thin radiator will condense more water every time, and if the engineer in his report makes a correct drawing of the radiators tested, so that on the face of the report he does not appear to deceive the public, but is careful not to mention the principle involved, the client has an opportunity of extolling the merits of his particular radiator in comparison with his opponent's, and to gain a commercial advantage not entirely warranted by the actual relative values of the goods themselves. It is suggested as a subject for topical discussion, the inquiry as to what extent engineers are warranted in making and publishing tests of this character.

Machinists' Supplies and Iron.

NEW YORK, May 31, 1890.

Iron—American Pig.—Prices rule quiet, with no change worthy of notice. The stock in hand is light, but buyers ask only for small quantities.

We quote Northern brands No. 1 Foundry, $18 to $19; No. 2, $17 to $17.50

Scotch Pig—It is difficult to quote prices for Scotch brands, owing to the small demand. There have been sales of Eglinton for $21 to $21.50; Dalmellington, $21.50; Coltness, $25 to $25.50.

Bessemer Pig—$18 to $19.

Steel Rails—Quiet at $31 to $32.

Bar Iron—Prices are held firm, but there is a shaky tendency. Quotations are the same as last week, viz.: $1.85 for Common, $1.90 for Medium, and $2 for Best.

Lead—Business is slack, but prices are held firmly at 4.30c. for immediate delivery. For future delivery prices are stronger.

Oil—Good Lard is selling at 52c.

Spelter—5¼c. to 5¾c.

Tin—21¼c. to 21½c.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Good pushing foundry foreman; jobbing shop. Give refs. Address BOX 22, AM. MACHINIST.

Mechanical draftsman wants position in New York or Brooklyn. BOX 24, AMERICAN MACHINIST.

Situation wanted by an exp'd mechanical draftsman, graduated in Sweden. "Good," AM. MACH.

Wanted—A first-class pattern maker. Steady work and good pay to the right man. Address Box 16, AMERICAN MACHINIST.

Foreman wanted to take charge of a machine shop; competent to manage men, and exp'd in steam engine building. Address N. M., AMERICAN MACHINIST.

Pattern Maker—first-class—wants a situation to have charge. 16 years' experience; age, 32; one year as foreman. BOX 23, AMERICAN MACHINIST.

Twenty-five good machinists wanted. Five good moulders wanted. Steady work to good men. Address Inman Mfg. Co., Amsterdam, N. Y.

Wanted—At once; first-class draftsman. Address, with full particulars, The Shaw Electric Crane Co., Milwaukee, Wis.

Wanted—First-class shafting turner; one acquainted with Pond's shafting lathe preferred. Address James Hunter & Son, North Adams, Mass.

Machinists Wanted—First-class floor hands and fitters of large experience and of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, O.

Draftsman Wanted—Presses, dies and general machinery. Write, stating age, where last employed, and salary expected, to the Dover Machine Works, Dover, Delaware.

A competent mechanical engineer (Scotchman, 25), technical education, would like position where exp. in marine engines and general engineering work can be utilized. Keane, 408 Broad st., Newark, N. J.

Wanted—A foreman boiler maker for a first-class establishment on the Pacific coast. He must thoroughly understand marine and stationary boilers; also repairing. Apply, by letter only, to Boilers, AMERICAN MACHINIST.

Wanted—Mechanical draftsman as ass't on metal-working machinery; one with technical education and one or two years' practical experience. Steady work and good pay to competent man. Fitchburg Machine Works, Fitchburg, Mass.

Wanted—A 1st-class moulder for a small foundry; principally on engine work. Must be able to handle a few men and push things. To an intelligent young man of good character this is a good opening. Address "Pennsylvania," AMERICAN MACHINIST.

Wanted—Position as sup't or foreman by a young man, 35, successful in the systematic manufacture of machinery and mechanical devices, and in the economical management of men. A draftsman and designer of automatic and interchangeable machinery, tools, jigs, etc. BOX 14, AMERICAN MACHINIST.

A practical foundry foreman desires a position as such. Has had many years' experience in all classes of work, especially engineering and machinery; also practical loam moulder. Can handle large crew. Best references given. Address I. P., Austin Ave. Hotel, 61 Austin Ave., Chicago, Ill.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 15 cents per line, each insertion.

Cheap 2d-h'd Lathes & Drills. S. M. York, Clev'd, O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order: Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

Wanted—Customers for our new Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Wanted—To buy second-hand lathes, planers and shapers of all sizes. Must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Electric motor and dynamo castings, yacht engine castings, model engines and electrical supplies. Address, for circular, L. G. Hall & Co., Electricians, 170 Merrimack st., Lowell, Mass.

For Sale—A splendid foundry and machine shop plant (partially destroyed by fire); a great opportunity for a good party; suited for any kind of mfg. business. Good location; good R. R. facilities; very cheap. Address L. W. Shafer, York, Pa.

We recently bought out a machine shop which had only been in operation 18 months, and have the following tools in excellent condition, which we will sell at a moderate price, viz.: One 24"x21' engine lathe, one 24"x24"x9' planer, one 12" heavy shaper. Lane's Foundry and Machine Works, Huntingdon, Pa.

WANTED AS SUPERINTENDENT,

A man thoroughly posted on general machine work, and fully competent to run a first-class shop. Must be a man of experience and well recommended. A good opening for the right man.

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Drop a postal card in the slot and get a Catalogue.
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BUFFALO, N. Y.

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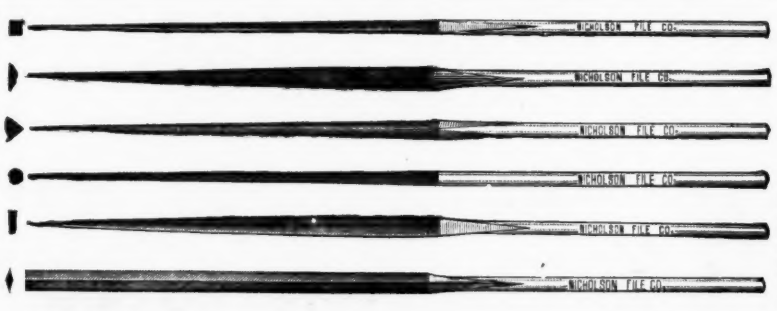

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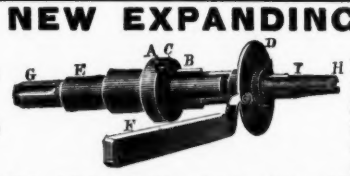

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3 .....1½ " 2 "	18
4 (with screws) 2 " 3 "	32
5 " " 3 " 4 "	44

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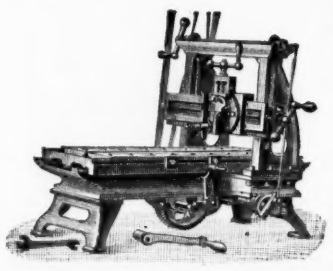

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Weight of Platen 100 lbs.
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Office and Works,
13 to 21 Main Street,
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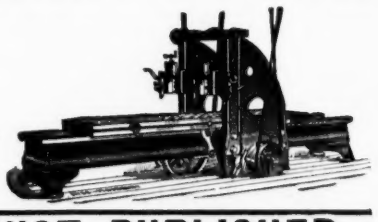

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A permanent and reliable method of attaching Hammers and all Edge Tools to Handles. Address,
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Scroll Saws, Circular Saws, Lathes Mortisers. **LATHE** Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. **687** Water St., Seneca Falls, N.Y.

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EITHER HORIZONTAL OR VERTICAL,
FOR STEADY EVERY DAY AND ALL NIGHT SERVICE AND AT A LOW PRICE, WRITE TO
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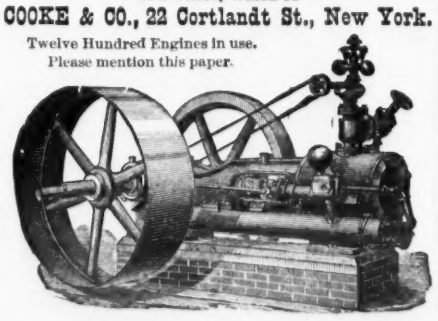
Twelve Hundred Engines in use.
Please mention this paper.



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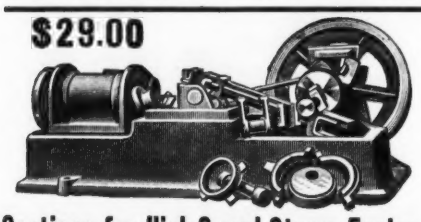

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CYLINDER, 4 in. x 4 1-4 in.

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Sets of Castings for Engine illustrated above, with *Cast-steel Shaft, Connecting Rod* and *Rock Shaft* and *Brass Bearings*, boxed and shipped on receipt of $29.00. Three sheets *blue prints* of working drawings, extra.

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Iron Planers, 26 inch to 84 inch wide.

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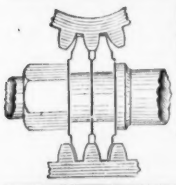

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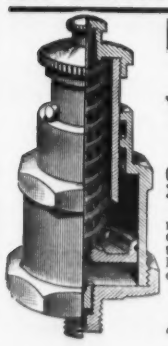

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APPEARING IN BACK ISSUES OF THE

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The following list is published to facilitate the ordering of back numbers containing them. Any of these issues can be ordered through any newsdealer, or of the publishers direct, at the price then ruling, viz.: 5 Cents a Copy.

1886.

Pattern Making, Various Articles on. By F. W. Barrows. Appearing in 29 issues.
Foundry Practice, Various Articles on. By Robt. E. Masters, appearing in 16 issues.
Strength of Different Mixtures of Cast-iron and Method of Testing. By Robt. E. Masters, April 24.
Foundry Practice, Articles on. By Foundryman. [L. C. Jewett.] Aug. 14, Sept. 25, Dec 18.
Foundry Practice, Articles on. By S. Bolland, May 8, 22, 29, June 26, July 10.
The Morton-Poole Roll Grinding Lathe. By Joshua Rose, J. G. Tramis, Geo. H. Babcock and C. A. Smith, July 3, 24, Aug. 7, 14, 21, Sept. 25.
Machine Shop Cost and Time Accounts. By A. J. Shaw, Henry Metcalfe and C. A. Burton, April 3, 17, May 8.
Tests of Iron. By David Spence, April 17, Oct. 30.
Traction on Grades. By A. B. Ropes, Oct. 30.
Wilson's Valve Gear for Locomotives, Oct. 30.
Casting Face-plates Face Up. By David Spence, Oct. 23.
A Job of Shaft Straightening. By F. L. Johnson, Oct. 23.
Inventory Valuation of Machinery Plant. By Oberlin Smith, Aug. 7.
Making a Cast-iron Sheave. By P. S. Dingey, July 31.
New Dredge Boiler designed by Norman Wheeler, July 17.
Core Oven with Rotating Back. By Thos. Wathey, July 24.
Universal Table for Lathe Change Gears for Screw Cutting. By Joshua Rose, July 24.
Gating, Clamping and Securing Chaplets. By Matthew Wiard, May 1.
Printing Frame and Manner of Making Blue Prints. By C. L. Redfield, July 31.
Some Pressure Tests. By C. O Sine, Nov. 27.
An Expanding Mandrel—Turning Tapers. By Chas. S Beach, Nov. 27.
Core Making in Foundries. By David Spence, Nov. 20.
Making Pattern for Spiral Grooved Drum. By Geo. Allge, Aug. 14.
Rolling Conic Sections Applied to Gears. By Geo. B. Grant, Nov. 6.
Ninety-inch Belpaire Fire-box Boiler, Nov. 6.
Spacing in the Milling Machine. By Chas. S. Beach, Aug. 21.
Engine Crossheads. By J. G. Tramis, Aug. 21.
Traction and Adhesion. By A. B. Ropes, Aug. 28.
Internal Key-seating on Milling Machines. By A. B Landis, April 17.
Tapping Holes in Boilers. By A. B. Landis, April 24.
How to True Emery Wheels. By L. Best, April 24.
Work and System in the Drawing-room. By C. L. Redfield, Aug. 28.
Oiling Lathe Carriage Ways. By Wm. H. Bradt, Aug. 28.
Moulding a Screw or Worm without Cores. By George Allge, Sept. 11, 18.
Power Absorbed in Cutting Cast-iron. By James F. Hobart. Sept. 11, 18.
Moulding Screw Propellers in Loam. By Chas. A. Devlin, Sept. 18.
Dimensions of Wrought iron Pipes in England. By A G. Brown, Sept 4.
Truing Up and Replacing Milling Machine Centers with Accurate Alignment. By A. B. Landis, Jan. 16.
Methods of Working and Tempering Steel By S. W. Goodyear, Jan. 9.
Slotting Tool. By J. J. Bingley, May 8.
How to Make Clean Solid Castings at Least Possible Cost. By Matthew Wiard, April 10
Truing Milling Machine Centers. By W. R. Ballou, April 10.
Lining Engine Lathes. By Chas. S. Beach, April 10.
Steam Piping. By J. G. Tramis, April 10.
An Equalizing Dog. By A. B. Landis, April 10.
Screw Cutting Dies. By John J. Grant, April 10.
Some Handy Shop Tools. By Fred. H. Colvin, April 3.
Moulding Bells for Blast Furnaces in Green Sand Without Patterns. By Geo. O Vair, April 3.
Furnace for Heating Long Bars. By W. G. Richards, April 3.
Cutting Tools—Roll Turning. By S. W. Goodyear, Oct. 16.
Hydraulic Forging. By J. Richards, July 10.
A "Box" Jig. By C. E. Simonds, June 19.
Cheap Testing Machine. By Wm. Merrill, Feb. 6.
Boring Deep Holes. By A. B. Landis, Mar. 27. May 8.
Working Steel and Iron. By S. W. Goodyear, Feb. 13.
Inventory Valuations of Patterns. By W. E. Matheson and others, Jan. 9, Feb. 13, 20, Mar. 6
Making Cast-iron Half Boxes. By A. J. Shaw, Feb. 6.
Draining Steam Pipes. By W. E. Crane, Feb. 6,
Brazing and Welding Iron. By J. F. Hobart, Mar. 6.
Deep Holes by Continuous Boring. By A. B. Landis, Mar. 27.
Slotting Machine Tool. By Wm. Foster, Mar. 20.
Compound Engines for Stationary or Factory Purposes. By W. H. Hoffman, April 24, May 1, 22.
Engineering Subjects, Articles on. By W. H. Hoffman, Mar. 13, July 24, 31, Aug. 21, Oct. 9.
Self-contained Engines. By W. H. Hoffman, Feb. 27, Mar. 6.
Curving Qualities of Locomotives with High and Low Centers of Gravity, Oct. 16.
Making Large Spur Gear Wheels. By P. S. Dingey, Oct. 2.
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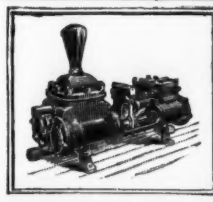

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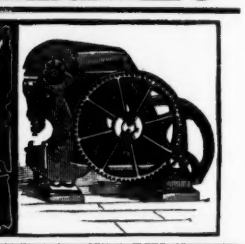

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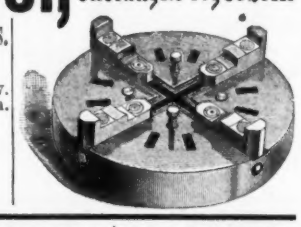

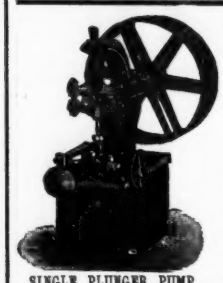

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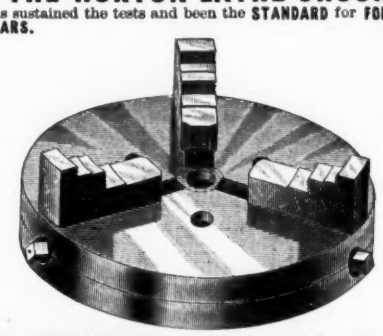

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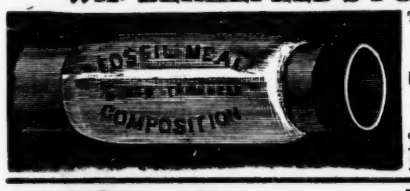

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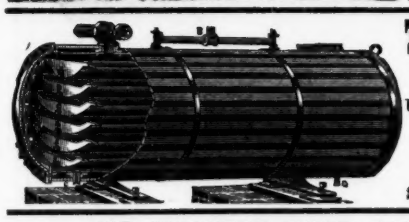

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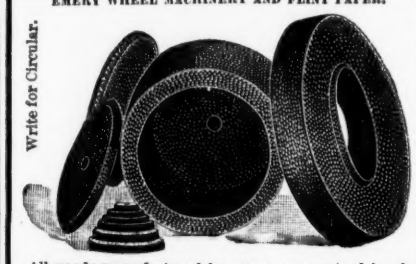

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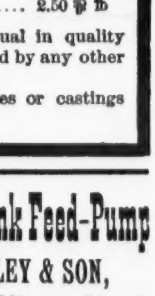

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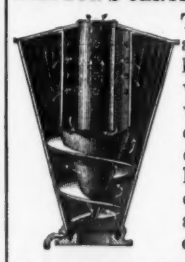

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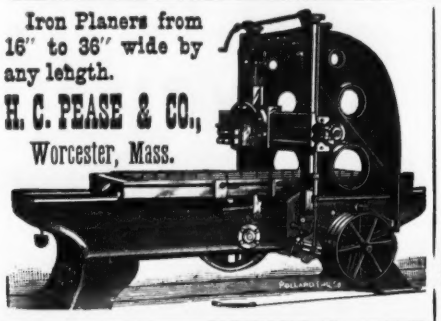

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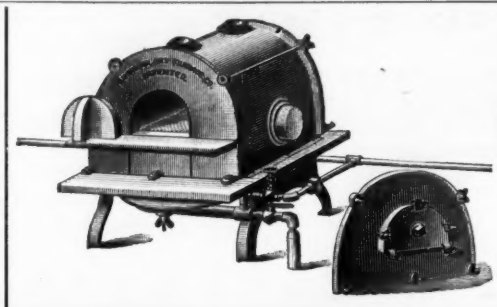

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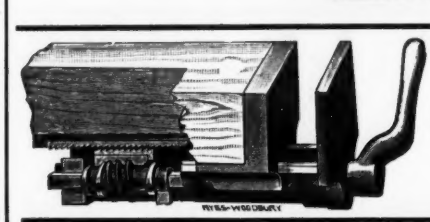

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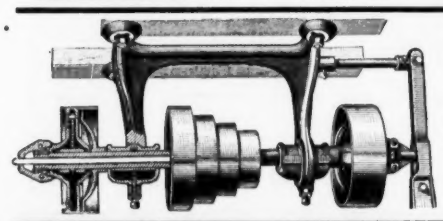

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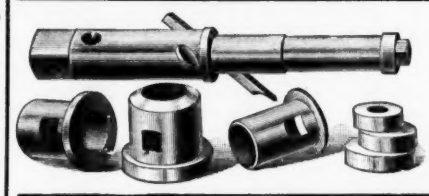

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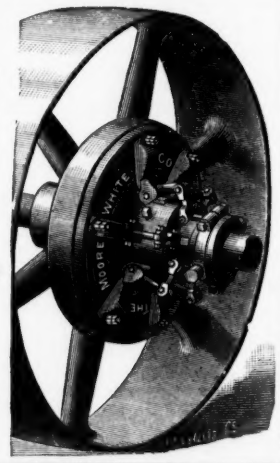

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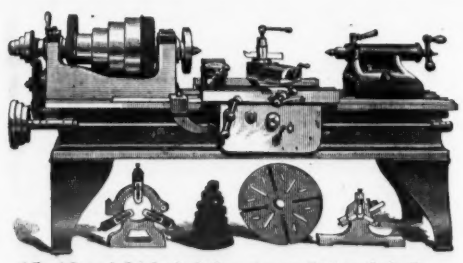

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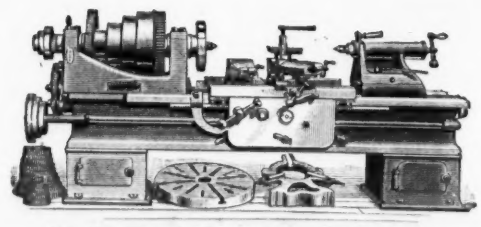

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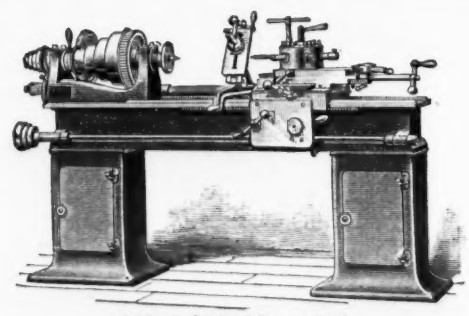

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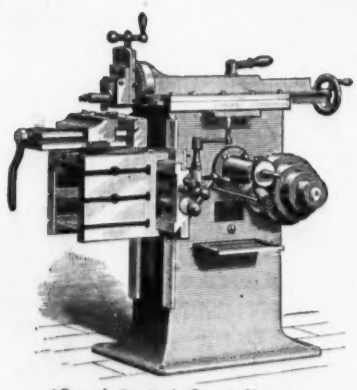
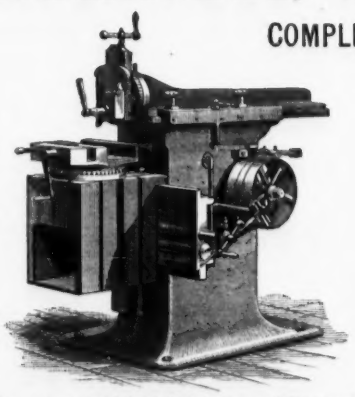
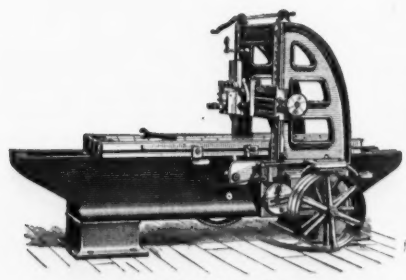


15 and 20-inch Crank Shaper.
Stroke changed and adjusted while running. Stroke at all times positive. Invariably plane to a line. Detachable Tables.

ENGINE LATHES
TURRET LATHES
IRON PLANERS



20, 26 and 32-inch Triple Geared Shapers.
Stroke changed while machine is running. Shaft can be passed through head of machine and key seat cut in same to any length. Extra heavy vises. Tables slotted on all sides.



24, 32 and 36-inch Planers.
Extra deep beds and tables. Powerfully geared. Plenty of Metal and designed for extra heavy duty. All Feeds and Shipper operated from both sides.
Improved Device for holding Planer Bolts.

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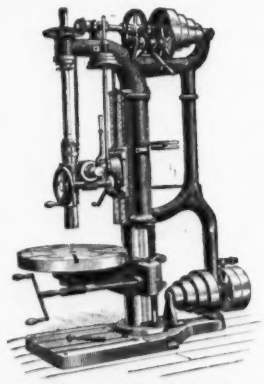
MILLING MACHINES
IRON SHAPERS



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Automatic stop to feed. Quick return on right side. Table operated from front. Large cones and long belts.

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Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

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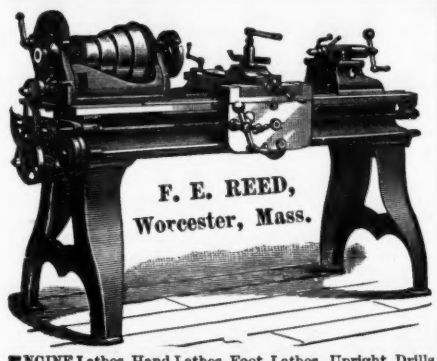

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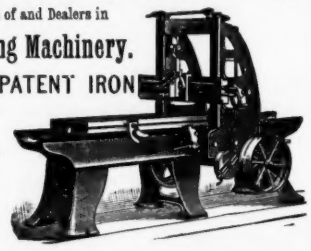

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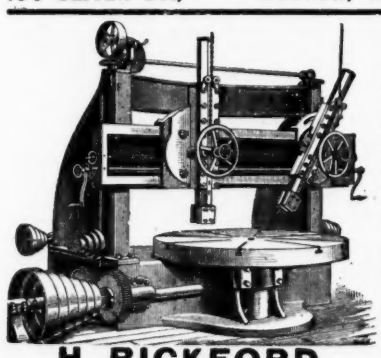

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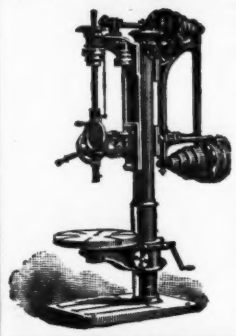

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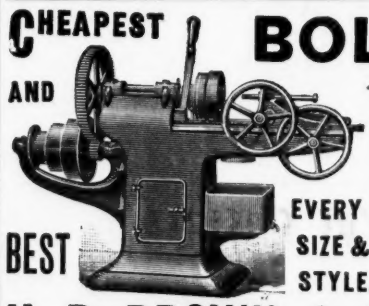

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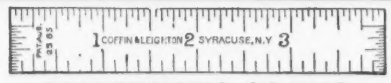

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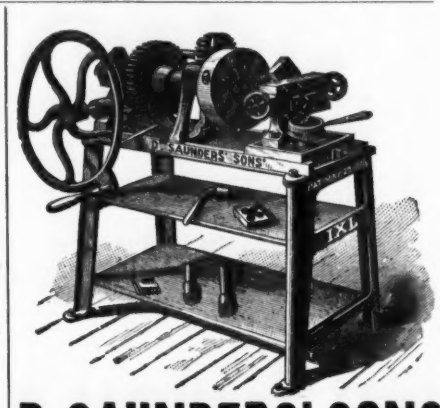

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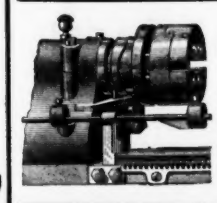

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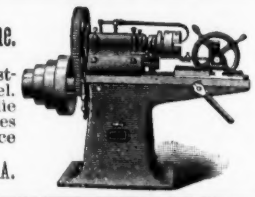

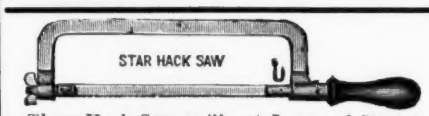

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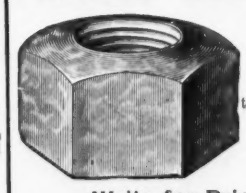

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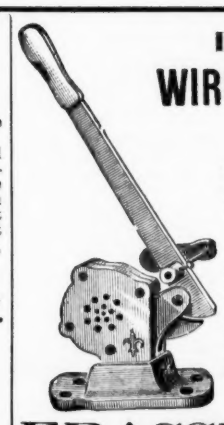

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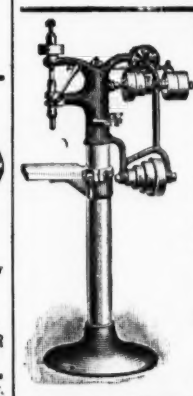

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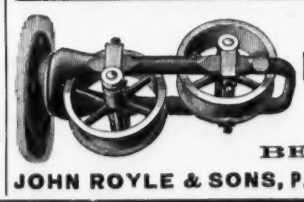

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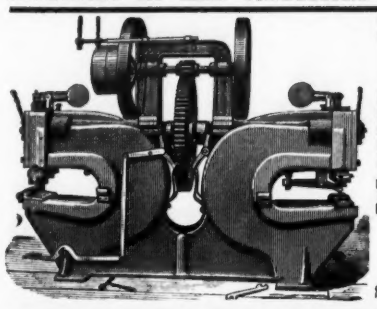

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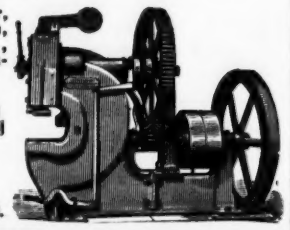

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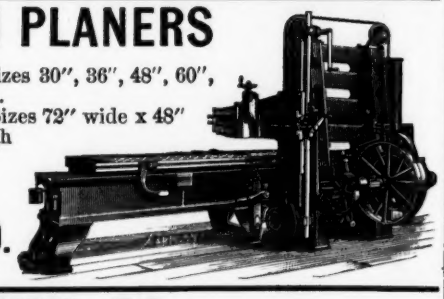

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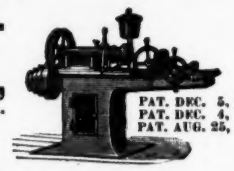

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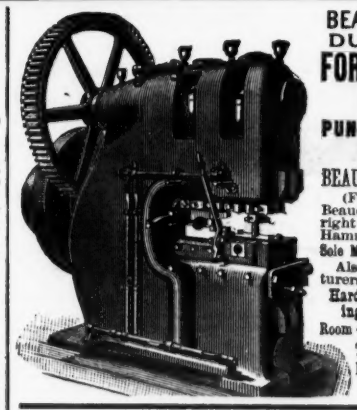

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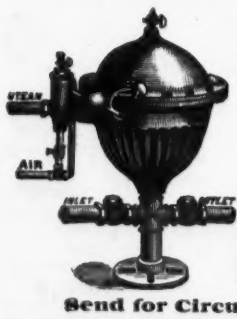

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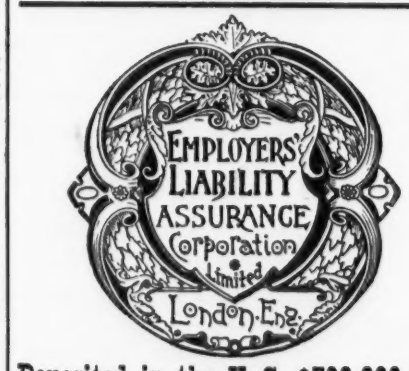

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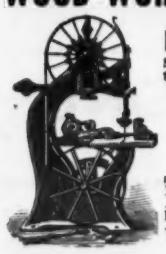

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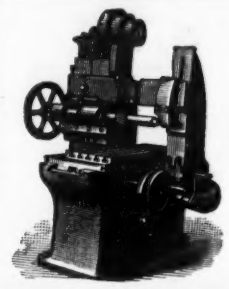

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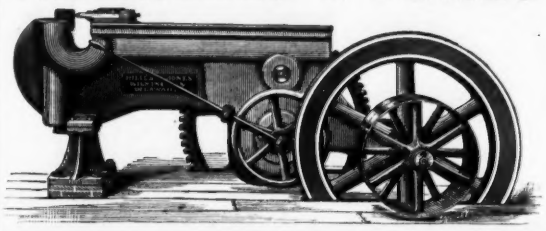

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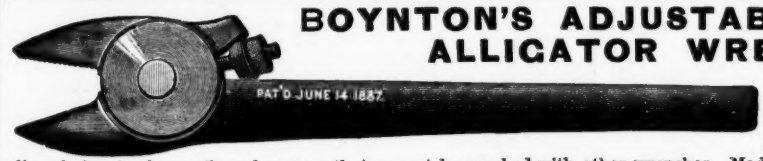

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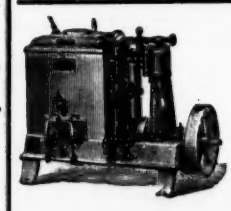

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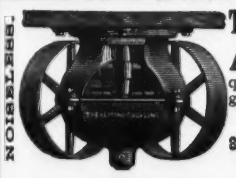

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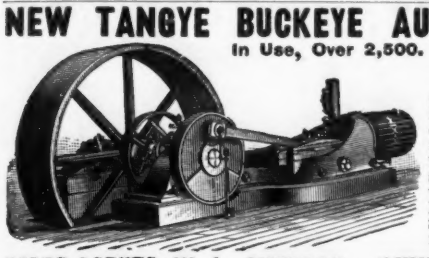

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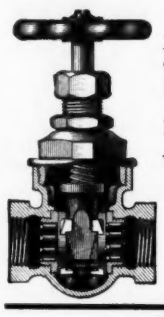

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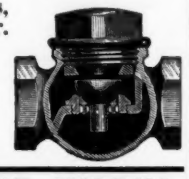

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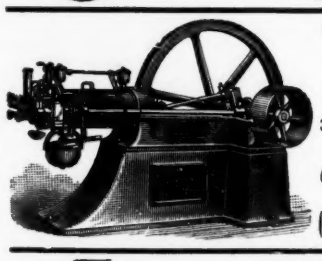

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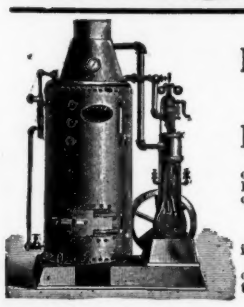

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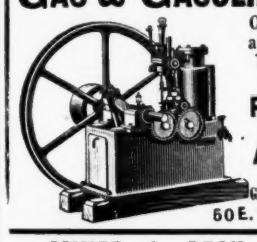

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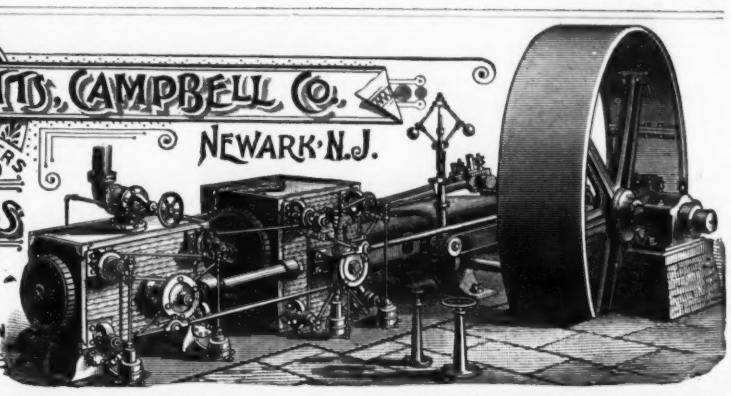

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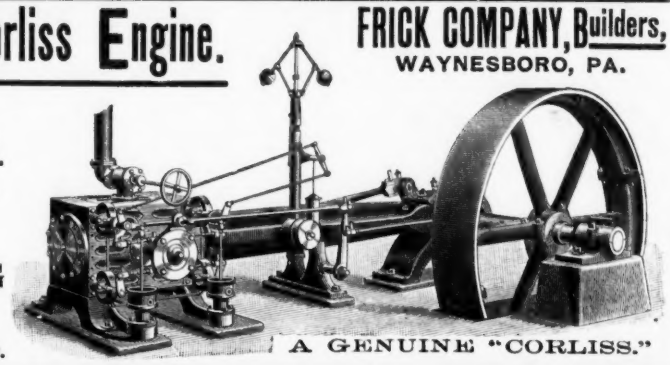

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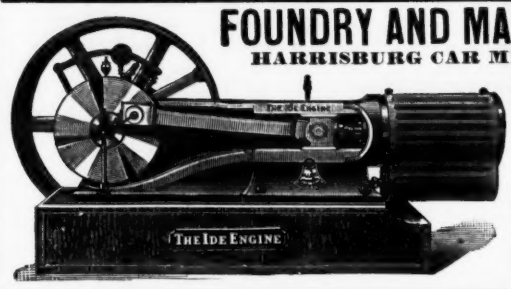

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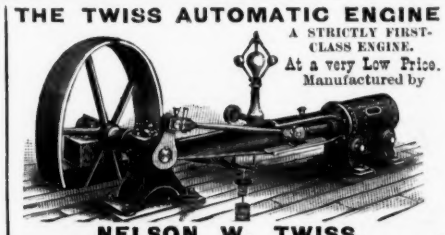

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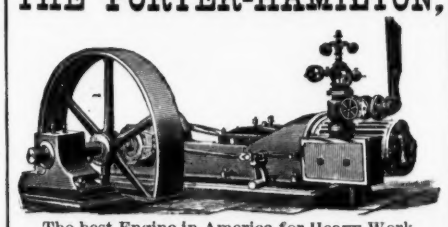

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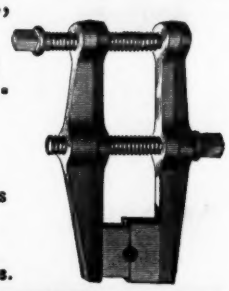

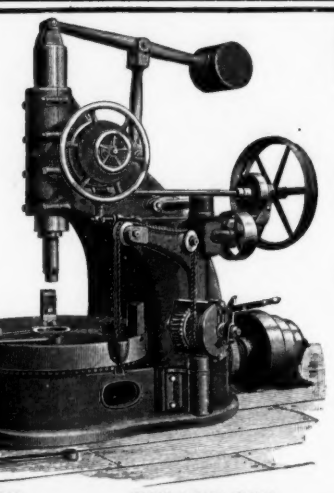

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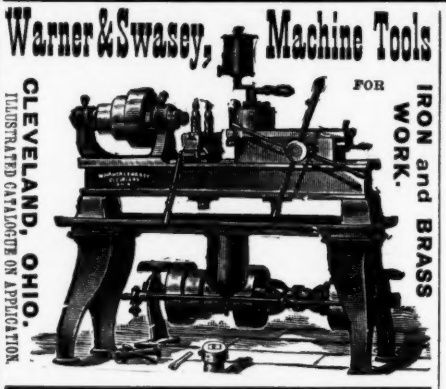

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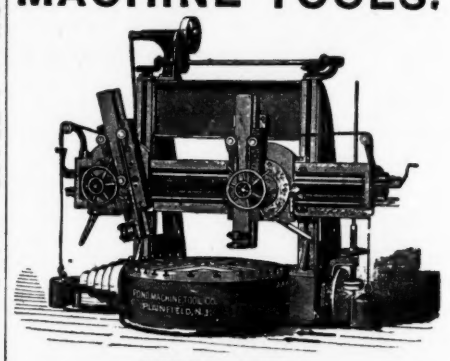

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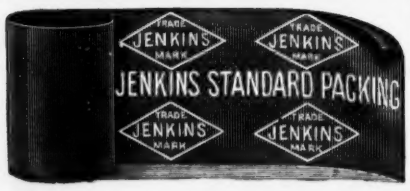

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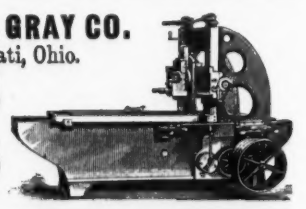

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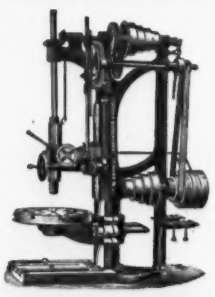

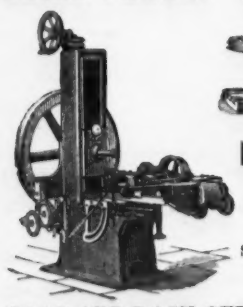

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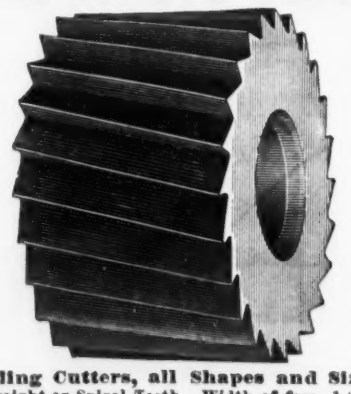

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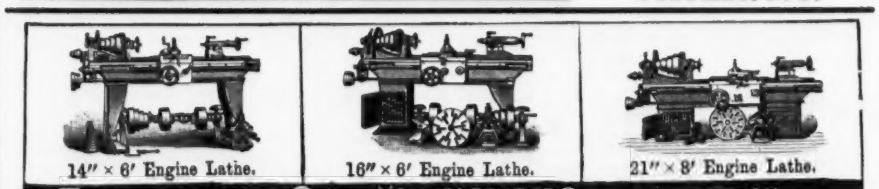

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